Contract 03-5-022-81
Research Unit 356
April 1, 1979 to March 31, 1979
9 pages plus 180 appended pages

ANNUAL REPORT

ENVIRONMENTAL ASSESSMENT OF SELECTED HABITATS IN THE BEAUFORT AND CHUKCHI LITTORAL SYSTEM

Principal Investigator: A. C. Broad
Western Washington University

A. C. Broad

Alexander Benedict

Kenneth Dunton

Helmut Koch

D. T. Mason

D. E. Schneider

Susan V. Schonberg

I. Summary of objectives, conclusions and implications with respect to oil and gas development.

A. Objectives for 1978. Our objectives for the calandar year, 1978, are paraphrased from our fiscal 1978 and 1979 proposals.

1. To characterize the infaunal, benthic biota and to identify the major elements of the motile, epibenthic fauna of the Beaufort inshore zone.

2. To investigate populations in the nearshore region of the Alaskan Beaufort Sea with particular reference to stability and to such dynamic factors as reproduction, recruitment, growth, migrations and predation.

3. To investigate and characterize the biota of the Stefansson Sound Boulder Patch and to initiate ecological studies of the biotic community.

4. To continue the identification of items of diet of major inshore animals and to assess the possible contribution of terrestrial detritus (peat from eroding shorelines) to food webs in the nearshore and inshore systems.

5. To determine the resilience of Arctic salt marshes subjected to several environmental stresses and, in light of this, to assess salt marshes as ecosystems.

6. To determine benzopyrene hydroxylase activity levels in Beaufort Sea fishes.

7. To investigate metabolic activities and physiological responses of winter-conditioned, Beaufort Sea invertebrate species in order to initiate assays of effects of crude petroleum on these forms in winter acclimatized conditions.

B. Conclusions. Most of the objectives outlined above are dealt with in separate, appended reports. Major conclusions from these sections are abstracted below.

1. The infaunal benthos of the Beaufort Sea inshore region is uniformly sparce and patchily distributed from about 2 m depth to at least 10 m.

2. The principal infaunal elements of the Beaufort inshore benthos are polychaete worms and bivalve molluscs. The most abundant species have been identified, and these seem uniformly distributed.

3. The mobile, crustaceans that comprise virtually all of the Beaufort nearshore and inshore epibenthic invertebrate biota have been identified. The major species are two mysid shrimps with many species of gammarid amphipods, the large marine isopod, Saduria entomon, and the calanoid copepod, Calanus hyperboreus also abundant.

4. During the summer season, the nearshore infaunal biota is fairly stable with trends in number and average size that may reflect movement into the nearshore zone in early summer, recruitment, growth and either predation or emigration in late summer. The mobile crustaceans are least abundant early in the ice-free season and reach a population peak in mid summer, possibly reflecting movement into the nearshore region followed by emigration in late summer.

5. The biota of the Stefansson Sound Boulder Patch is unlike that of those marine communities previously known from the Beaufort Sea and, while the individual species are not new, the association of them in a sessile, kelp-dominated community has not been reported before.

6. Many marine invertebrates of the Beaufort Sea ingest peat, but seem to derive no nutritional benefit from it. Gammarus setosus, however, does assimilate some of the organic content of ingested peat and is able to assimilate part of Laminaria as well.

7. Arctic salt marshes are sensitive to oil, cover by sand, or physical disturbance, and marshes in the north (Beaufort coast) are several times moe susceptible to damage (or are damaged by less of any stressor) than are marshes near the Arctic circle (Chukchi coast).

C. Implications.

1. Except for the Stefansson Sound Boulder Patch, there is no known unique or unusual benthic habitat in the Beaufort, inshore or nearshore regions. The implication for exploration and development is that, from the viewpoint of the benthic biologist, no part of the nearshore or inshore zones is preferable to any other--except for Stefansson Sound. Data previously reported by us and those reported here for Nuvagapak Lagoon, indicate that the benthonic biomass of lagoon systems and that, in general, alteration of a unit area of lagoon bottom will have a greater overall effect on benthos than will comparable alteration of a similar area of open sea bottom.

2. The Stefansson Sound region is a biological habitat that, for practical purposes, may be considered unique and, at least until this community and its overall contribution to the Beaufort Sea are better known than now is the case, should not be disturbed.

3. Carbon from detritus of terrestrial origin enters the Beaufort marine food web through Gammarus setosus and, possibly other species. The full importance of this contribution is yet to be evaluated, but there are implications for attempts at shoreline stabilization and, interference with currents that transport materials alongshore. We have data that indicate a relationship between the presence of peat and the abundance of

benthos. Peat enters the system as material of large particle size and, in time, breaks down possibly as a result of being inqested by animals. The organic content of peat of small particle size is reduced over that of the larger sized (and, presumably, younger) peat. Directly or indirectly, this organic material becomes available to the marine biotic community. Because developments which may require shoreline stabilization and interference with longshore transport are imminent and because this same development may introduce into the marine environment materials that can affect the availability of detrital carbon to the marine biota, it is important that the extent of this contribution and the pathways by which it occurs are known at the earliest possible date.

5. Arctic salt marshes are important in the feeding of geese and brant as well as other animals. These marshes are sensitive to oil, and those on the Beaufort coast especially so. Barring accidents during exploration, development and production, these marshes, which are usually above water level, are not threatened by petroleum development <u>per se</u>, but this sensitivity should be borne in mind and continqency plans for Protection of marshes is the event of accidents should be made.

11. Introduction:

This report consists of five, separate appended sections or chapters. Each is intended to be complete in itself, and each either deals independently with introductory material including sections on state of knowledge, the study area, sources and rationale of data collection, methods, presentation of results, conclusions, and discussion--or such has already been presented in previous annual reports.

The first section deals with the inshore benthic and epibenthic fauna, and is the result of the 1977 Beaufort Sea cruise of the RV ALUMIAK. Now being processed in our laboratory are samples from the 1978 ALUMIAK Beaufort cruise in which some of the same stations were revisited, and more thorough coverage of the current lease zone was possible.

The second section is a presentation of data obtained in repetitive, nearshore samples of Beaufort Sea sites made in 1977. Awaiting laboratory analysis are comparable samples from the Chukchi coast made in 1978.

In the third section of the report, a description of the Stefansson Sound Boulder Patch based on field work carried out in 1978 and part of 1979 is given. Field work in Stefansson Sound is continuing.

The fourth section describes experiments done on feeding of *Gammarus setosus* and other nearshore species during the summer of 1978. These experiments will continue in 1979.

The fifth section of this report is a brief presentation of some of the effects of perturbation of Arctic salt marshes in 1977 and 1978 and updates a comparable treatment made a year ago. It is noteworthy that effects of oil added to marshes in 1977 were intensifying in 1978. Subsequently, we will present results of the use of marsh invertebrates to assay for oil (or effects of oil on marsh invertebrates) and results of a study of black brant dependence on marshes.

Not dealt with further in this report is the measurement of benzopyrene hydroxylase activity. Fishes collected during the 1978 summer thawed in transit to Bellingham, casting doubt upon the negative results obtained. Additional fish were obtained in 1979, but these have not yet been analyzed. Since these were collected prior to drilling, we still should obtain activity levels that precede any petroleum activity in the Alaskan Beaufort Sea.

Finally, physiological experiments in progress are described briefly in the report of fourth quarter activities.

Summary of Fourth Quarter Operations

I. Field and laboratory activities.

A. Field work

1. At NARL, Barrow: physiological investigations.

   a. D. E. Schneider - January 10 to March 15
   b. J. Hanes - January 16 to end of quarter
   c. W. Pounds - February 16 to end of quarter

2. At Deadhorse and Stefansson Sound Dive Site: K. Dunton and dive team (J. Olsen, P. Plesha, G. Smith)

   a. February 21 to March 15.

B. Scientific Party (except as noted, all of Western Washington University)

1. A. C. Broad, Principal Investigator (half time)
2. D. E. Schneider, Associate Investigator
3* Ken Dunton, Assistant Investigator
4. Helmut Koch, Laboratory Supervisor
5. James Hanes, Marine Technician (after January 16)
6. Mark Childers, Research Aide
7. Wendy Pounds, Research Aide (after February 16)
8. Susan Schonberg, Research Aide (half time)
9. Alexander Benedict, Computer Programmer (hourly wages)
10. Laboratory Assistants (hourly wages)

    a. Dawn Christman
    b. Neil Safrin
    c. Russell Thorsen
    d. Jon Zehr

11. Work-study students (no cost to contract)

    a. Ron Adams
    b. Robert Crugger
    c. Philip Denny
    d. Bruce Fletcher
    e. Gary Smith
    f. Russell Wellington

12. Contracted services (not University employees)

    a. John Olson, diver
    b. Paul Plesha, mechanic and technician
    c. Gary F. Smith, diver

C. Methods -- see text of appropriate sections of annual report.

D. Sample localities -- see sections 3 and 4 of annual report.

E. Data collected or analyzed.

1. See sections 3 and 4 of annual report
2. Laboratory work continued on analysis of 1978 ALUMIAK samples.

F. Milestone chart update: none required.

II. Results:

The investigation of physiological responses of arctic shallow-water marine animals to winter conditions was continued during the second quarter. Major emphasis was placed upon determining tolerance levels to salinity extremes and the effect of salinity upon determining tolerance levels to salinity extremes and the effect of salinity upon respiration. The following experiments were either completed or initiated:

Acute salinity tolerance. Animals were transferred directly from their normal field salinity of about 32‰ to a stress salinity. Experiments were carried out in pint plastic freezer boxes containing about 400 ml of the desired salinity and 5 animals. At least 10 animals were exposed to each stress salinity. The animals were checked daily for mortality and a subjective rating of their activity level was made. Experiments were terminated after 7 days. Table Q-1 lists the acute salinity tolerance experiments run.

Table Q-1. Acute Salinity Tolerance Experiments

Species	Location	Salinity Range
Anonyx nugax	NARL	10 - 70‰
Boeckosimus affinis	Elson Lagoon	10 - 70%
Mysis litoralis	NARL	5 - 70‰

Gradual salinity tolerance. Animals were transferred from their normal field salinity of about 32‰ to either higher or lower salinities in 5‰ increments every 2 days. Mortality and subjective rating of their activity level was recorded daily. Table Q-2 lists the gradual salinity tolerance experiments run.

Table Q-2. Gradual Salinity Tolerance Experiments

Species	Location	Salinity range
Anonyx nugax	NARL	32 - 10‰
Anonyx nugax	NARL	32 - 60‰
Mysis litoralis	NARL	32 - 0.25‰
Mysis litoralis	NARL	32 - 65‰
Saduria entomon	NARL	32 - 75‰

Crude Oil Toxicity: Preliminary experiments were begun to assess the toxicity of sea water--crude oil emulsions to some of the common species. Prudhoe Bay crude oil was agitated with sea water for one hour on a mechanical shaker. The emulsions were transferred to sepratory funnels and allowed to settle for 3 hours before being directly used in tolerance experiments. Animals were exposed to emulsions for 4 days and fresh emulsions were prepared daily. The animals were checked for mortality and a subjective rating of their activity was made daily. Anonyx nugax and Mysis litoralis were tested at 32‰ salinity and oil concentrations of 25, 250, and 1000 µl/50ml sea water. Anonyx nugax was tested under double stress conditions of 32‰ and 40‰ with an oil concentration of 25 µl/500ml sea water.

Respiration measurements. The rate of O_2 consumption was determined as a function of salinity for Anonyx nugax, Boeckosimus affinis and Mysis litoralis. Measurements were made using a Gilson Differential Respirometer with 15 ml flasks. Single animals were placed in 5 ml of the appropriate salinity sea water and run for at least 6 hours. Bath temperature was maintained at -1.0°C and the room was darkened to simulate winter light conditions. Animals were transferred from their field salinity of 32‰ to the test salinity in 5‰ increments every 2 days. They were maintained at the test salinity for 6 days prior to determination of their respiration rates. At least 16 animals were run at each test salinity. Anonyx nugax was run at 15, 20, 32, 40, 45, and 50‰. Boeckosimus affinis was run at 10, 15, 20, 32, 40, 45, 50, and 55‰. Mysis litoralis was run at 10, 15, 20, 32, 40, 45, and 50‰.

Experiments on the effect of crude oil-sea water emulsions on the respiration of the above species were initiated but not completed during this quarter.

The results of the physiological studies will be presented in a later report when a full data set is available for interpretation. Analysis of the existing data indicates that Anonyx nugax is the least euryhaline of the 3 species studied and does not tolerate salinities out of the range 15 - 45‰ very well. Boeckosimus affinis is the most euryhaline species and tolerates salinities in the range of < 10‰ to 65‰ successfully. Mysis litoralis is intermediate and survives well at salinities ranging from about 5 - 45‰.

The investigation of the trophic relationships of the Arctic shallow-water marine animals continued with the collection and preservation of freshly produced fecal pellets for later analysis. Some of these pellets have been analyzed during this quarter as time permits. A single peat assimilation experiment was performed under winter conditions with Mysis litoralis. The results of this experiment have been included in the annual report, section 4.

Activities of the team working in Stefansson Sound have been incorporated in section 3 of the annual report.

III. Estimate of funds expended.

	Amount Budgeted[1]	Amount Spent[2]		Amount Remaining
Salary PI	58,558	53,577		4,981
Salaries Associates	72,707	103,023	(23,586)	-30,316
Salaries, other	169,892	164,062	{6,472)	5,830
Fringe	45,182	44,346	(7,516)	836
Travel & Freight	40,825	41,544		-719
PI Logistics	92,451	37,045		55,406
Supplies & Contracts	9,000	30,620	(11,950)	-21,620
Equipment	17,265	19,220		-1,955
Computer Costs	7,800	5,441		2,359
Overhead	138,633	122,940	(16,622)	15,693
Totals	$652,313[1]	621,818	(66,146)	30,495

[1] Includes basic contract for fiscal 1979 plus Western Washington University contribution. Does not include funds for winter process studies requested in supplemental proposal for fiscal 1979 for which contract amendment has not been received.

[2] Estimated as of March 31, 1979 and includes $66,146 (amounts shown in parentheses] already spent for winter process studies.

A further contribution to knowledge of the benthic and epibenthic fauna of the Beaufort Sea inshore region.

A. C. Broad

Previously, we have reported that the Beaufort Sea nearshore[1] (less than 2 m deep) fauna is poor in species, number of individuals, diversity, and biomass, and that the Chukchi coast north of Point Hope does not differ from the Beaufort littoral in these parameters. The Beaufort inshore (2 to 20 m) benthic infauna differs from that of the nearshore region in that it is both richer and more diverse. These same differences do not obtain when the motile, epibenthic animals of the Beaufort nearshore and inshore zones are compared, and our data indicate that the same population of motile organisms is sampled in the Beaufort nearshore and inshore and in the Chukchi nearshore north of Point Hope. There are real differences in biomass and number of species of infaunal animals in the Chukchi Sea north and south of Point Hope. A comparison of diversity, however, does not indicate the same differences. The number of motile, epibenthic species found south of Point Hope exceed those north of that point, but the data *on* diversity and biomass do not indicate that the populations are different.[2]

Data collected in 1977 during the cruise of RV ALUMIAK from Barrow eastward to Tapkaurak Entrance (at which point further progress was impeded by ice) add to our understanding of the fauna of the inshore region and are reported in this section.

Methods

RV ALUMIAK sailed from Barrow on August 2, and returned on August 26, 1977. During the cruise 17 transects were made of the inshore region of the Beaufort Sea and 44 stations were sampled. The number and type of samples made at each station and the location of all stations are given in appended table 1.1.

The sampling protocol at each station was:

A. For infaunal benthos samples a 0.1 m^2 Smith-McIntyre grab was employed. With few exceptions, three grab samples were made at each station. The samples were washed on board in a cascading, multiple seive system in which the controlling (lower) mesh size was of 0.423mm NITEX. The larger stones retained in the coarser seives were inspected and, unless harboring sessile animals, discarded. All other retained material was bagged on board, preserved in hexamine-buffered formalin, and shipped to Bellingham for analysis.

B. Motile, epibenthic animals were sampled by towing a WILDCO scrape/skid dredge (Cat. No. 171) with 1.05mm mesh net for five minutes. To assure that this net actually sampled at the bottom, approximately 2 kg of lead weights were attached to the towing bridle about 45 cm ahead of the net itself. Samples were preserved on board in buffered formal in.

C. Surface plankton was sampled by towing a 20.3 cm diameter, conical plankton net of 153μm nylon mesh for five minutes. The samples were preserved immediately in hexamine buffered formalin.

D. A sample for sediment analysis was taken with either the Smith-McIntyre or with a 0.1m^2 Van Veen grab. A sample of approximately 500 ml was preserved for subsequent analysis.

E. A temperature-salinity profile was made by means of a Yellow Springs Instrument model 33 SCT meter. A Secchi disc reading was made, and the depth was measured by means of a lead line.

F. In Bellingham, all dredge and grab samples were soaked to remove formalin and sorted under 2x magnification (Luxo illuminated magnifier). In most instances, the samples were stained with a rose bengal solution. All organisms were removed, identified, counted and weighed to the nearest mg by species (wet weight taken immediately after blotting dry), and then preserved in 35% propanol or 70% ethanol.

G. Plankton samples are not treated further in this report.

H. Sediment samples were dry-sieved with a U.S. standard seive series using a mechanical sorter or, for finer particle sizes, wet seived in comparable seives. Particles of phi sizes -2 to -4 were considered gravel. Phi sizes -1 to +3 were called course sand. Fine sand was phi size +4, and smaller particles were classified as mud. Sediment data are referred to below but will be reported elsewhere.

Results

Salinity and temperature at each benthic station and characterization of major substrate types are given in appended Table 1.1. Species of all animals captured in the grabs and dredge are listed in appended Table 1.2. Data on animals taken in grabs are found in appended Tables 1.3 to 1.46. The catches of motile epibenthic organisms are summarized in appended Table 1.47.

Due possibly to rain and the resultant difficulty in keeping the SCT meter dry, we sometimes found salinity and temperature readings tobe erratic. Those of questionable validity are marked with an asterisk in Table 1.1

Discussion

Each transect was sampled at depths of approximately 5 and 10 m, and some were continued shoreward to a 2 m sample. In order to test whether there were important faunistic differences between these depths, the data were grouped around three class intervals (2 - 3.5 m, 5 - 6 m, and 9 - 11.5 m) for comparison. The result of 3-way analyses of variance and, where indicated, Newman-Keuls multiple range tests, are given in Table 1.48. What differences are revealed by these tests do not support the notion of depth-dependent, faunistic differences. Instead, it is most reasonable to accept a general notion of patchy uniformity in the 2 - 10 m depth region of the Beaufort shelf of Alaska.

When the infaunal data are grouped by depth intervals, the variances of sample populations are high, and standard deviations are usually larger than sample means. Ranges of both biomass and number of animals grouped

Table 1.48. ANOVAs of Smith-McIntyre grab samples made at three depth intervals: 2 = 2-3.5m; 5 = 5-6m; 10 - 9-11.5m (See Table 1.1 for depth at each station). For each analysis there are 122 degrees of freedom within the three populations, and 2 between them. Where F values indicate that the three samples were not from a single population ($p < 0.05$), a Newman-Keuls multiple range test was run to identify differences.

	F	P	Differences
No. Animals	0.702	0.524	
Mass Animals	2.861	0.054*	2 ≠ 10
No. Polychaetes	7.945	0.940	
Mass Polychaetes	1.348	0.281	
No. Oligochaetes	9.824	0.00001**	2 # 5, 10
Mass Oligochaetes	4.444	0. 008**	2 # 5, 10
No. Gastropod	9.558	0.00001**	2, 5 ≠ 10
Mass Gastropod	0.422	0.668	
No. Bivalves	1.761	0.183	
Mass Bivalves	3.853	0.017**	2 = 5 = 10
No. Isopods	0.223	0.785	
Mass Isopods	1.831	0.170	
No. Amphipods	3.672	0.021**	5 ≠ 2, 10
Mass Amphipods	2.206	0.113	

by taxonomic category are great at all depths. In a few instances adjacent samples made at the same station differ from one another by orders of magnitude. In general, the variation between biomass samples at single stations exceeds that between numbers of animals. These differences may be attributed in part to large individuals which, although not numerous, account for sometimes large portions of biomass samples. Noteworthy are the polychaetes Arenicola glacialis and Sternaspis scutata, the isopod Saduria entomon, and the bivalves Astarte borealis, Macoma loveni, and Macoma calcarea. Grabs do not always penetrate uniformly due to substrate differences, and substrates do not accommodate the same populations of animals. Still, despite these inherent sampling errors, the data indicate a patchy distribution of animals in the inshore zone of the Beaufort Sea.

Of the 44 benthic stations sampled for infauna, 32 have peat in the substratum, and 12 did not (see Table 1.1). Not only was peat not noted on board ship at these 12 stations, it was not found in the material returned to our laboratory. There are fewer total animals and smaller biomass, and comparable differences in both polychaetes and bivalve mollusks and in the biomass of amphipods, in the no-peat stations as shown in Table 1.49, but the significance of this may have less to do with the peat than with other factors. Absence of peat from a station in a region in which it usually is found, implies some reason why peat does not settle or remain, and this rather than the lack of peat may affect the settling of larvae or survival of infaunal species.

Table 1.49. ANOVA of Smith McIntyre grab samples made at stations where peat was found and at stations where peat was lacking. For each analysis there are 122 degrees of freedom within the two populations and 1 between them. The 12 stations at which peat was lacking are indicated on Table 1.1.

	F	P
No. Animals	14.600	0.00002**
Mass Animals	13.445	0.00004**
No. Polychaetes	21.411	0.0000002**
Mass polychaetes	12.233	0.00009**
No. Oligochaetes	0.954	0.353
Mass Oligochaetes	0.263	0.609
No. Gastropod	0.881	0.373
Mass Gastropod	1.382	0.256
No. Bivalves	7.266	0. 003**
Mass Bivalves	15.563	0.000008**
No. Isopods	3.665	0.047*
Mass Isopods	0.666	0.440
No. Amphipods	2.407	0.119
Mass Amphipods	5.498	0.012**

Analysis of the peat-free stations shows that 6 are at depths of 2-3m, 3 at 5-6m and 3 at 9-10m. This represents 55% of the 2-3m stations and much lower proportions (19 and 18% respectively) of the intermediate and deeper stations, but it does not relate the lack of peat to depth alone. At the stations where peat was not found, bottom sediments were taken. Nine had less than 4% mud (phi size $\leq +4$), but two had more than 50% (54 and 56%) mud. Of the 32 stations where peat was found, one was not sampled for substrate analysis; 18 had more than 50% mud (average 77.2%), 10 had from 8 to 48% mud (average 28.4%), and 3 had only 1 to 3%

mud). The species most abundant at the stations where peat was not found were essentially the same as those found elsewhere.

Tables 1.3 to 1.46 list the infaunal species considered most abundant at each station. A species was included if it were present in a quantity equal to either 1 gram of wet weight per m^2 or 100 individuals per m^2 in at least one sample. This evaluation, therefore, is a subjective one, but results in listing species that maybe numerous but individually small and those that are large but occur less often. Clearly, the characteristic infaunal organisms of the Beaufort inshore region are polychaetes and bivalves. Those polychaetes that were most frequently encountered in a sequence of roughly declining abundance are: Prionospio cirrifera, Tharyx spp., Chone sp., Terebellides stroemi, Ampharete vega, Scolecolipides arctius, Melanis loveni, Spio filicornis, Praxillella praetermissa, Scoloplos armiger, Sternaspis scutata, Nephtys caeca, and Sphaerodoropsis minuta. The most abundant bivalves, again in a descending sequence of frequency of appearance in the tables, are: Portlandia arctica, Liocyma fluctuosa, Portlandia intermedia, Boreacola vadosa, Macoma loveni, Macoma calcarea, Cytodaria kurriana, Astarte borealis, and Axinopsida orbiculata. These polychaete and bivalve species comprise most of the characteristic, infaunal benthos of the Beaufort inshore zone.

We have been unable to detect variations in the composition of this characteristic fauna with depth, presence or absence of peat, or substrate type. In stations nearest beaches, bivalves usually are absent, possibly because the stress of ice gouging is too great, and there appears to be an increase in bivalve biomass with increasing depth, but our data do not support this statistically.

Previously, we have reported that the numerous (although individually very small) enchytraeid worms found in the nearshore zone do not occur in the inshore region. Our Tables 1.3 to 1.46 show Oligochaetes in several of our 5 and 10 m stations. With the exception of station C1B, at the eastern extremity of our sampling and possibly under some influence from the MacKenzie River, all of these oligochaetes are tubificids instead of enchytraeids.

The motile, epibenthic fauna of the Beaufort inshore region as revealed by sampling with a small epibenthic sled net with 1.05 mm mesh is summarized in Table 1.47. In every instance some usually very minor part of the catch is not listed because the unlisted animals were generally insignificant in number and in biomass but included a large variety of animals that would have made the species column needlessly long. Most of these animals were polychaetes or other infaunal organisms that indicated that the net, instead of sliding along the bottom on its runners, sometimes was digging in. This was particularly evident at stations with especially soft substrates. The efficiency of the net in sampling epibenthic organisms, therefore, varied with firmness of the bottom. Divers have noted avoidance of nets of this type by mysids and other crustaceans which is also reason to question whether catches reported are always comparable to quantities otherwise sampled or even to other samples made with the same gear.

With these qualifications, it is still evident that the epibenthic fauna of the Beaufort inshore region consists of, in a sequence of decreasing abundance: Mysis littoralis; several species of amphipods, especially Acanthostepheia behringiensis, Onisimus glacialis, Rozinante fragilis, Gammarus zaddachi, Boekosimus affinis and B. plautus, Monoculopsis longicornis, Monoculodes sp., Apherusa megalops and A. glacialis, Halirages sp., Weyprechtia pinguis, Acanthostepheia incarinata, and Gammaracanthus loricatus; Mysis relicts; Saduria entomon; Colanus hyperboreus; and Thysanoessa raschii. All are crustaceans. Gammarus setosa and Onisimus litoralis, probably the most abundant epibenthic crustaceans of the nearshore zone, were less numerous in our samples from the inshore region than the species named above. Parathemisto libellula, while present, was not abundant, but this may reflect the efficiency of a net fishing near the bottom instead of the actual abundance of this important food species.

Finally, six of the stations sampled in 1977 also were sampled in 1976. A comparison of these stations for the two years is given in Table 1.50. At these six stations, and generally otherwise in 1977, amphipods accounted for a smaller proportion of the benthic infaunal biota than was so in 1976. In both years, polychaetes and bivalves were the more consistent infaunal elements with both showing usually a higher proportion of totals in 1977.

Table 1.50. Comparison of infaunal benthos at six Beaufort Sea inshore stations sampled in 1976 and 1977. Data are in percent of total for both number/m^2 and wet weight biomass/m^2.

STATION	C4F				HØA				HØB				NIA				P2D				P2E			
Index/m^2	No.		Mass		No.		Mass		No.		Mass		No.		Mass		No.		Mass		No.		Mass	
Year	76	77	77	76	76	77	76	77	76	77	76	77	76	77	76	77	76	77	76	77	76	77	76	77
POLYCHAETES	92	86	57	38	3	47	6	41	35	67	17	51	79	39	40	10	2	0	0	1	36	66	11	36
OLICOCHAETES					7	2	1														19	11	0	1
GASTROPOD										2		0		1		4						2		3
BIVALVES		8		12	11	8	28	38	2	21	4	44	15	54	27	72					13	15	20	12
ISOPODS	1	0	36	40	0	0	15	19					0	0	27	13					0	1	49	23
AMPHIPODS	7	5	76		78	41	50	1	62	7	78	1	1	0	0	1	98	1	100	13	30	5	19	18
OTHER	0	1	0	4	1	2	0	1	1	3	1	4	5	6	6	0		99		86	2	0	1	7

NOTES

[1]In our prior reports we have referred to the region from 2 to 5 m deep as "nearshore" and have used "littoral" for depths of less than 2 m. More recently (see Weller, G. *et al*., 1978. Environmental Assessment of the Alaskan Continental Shelf: Interim Synthesis: Beaufort/Chukchi. N.O.A.A. Environmental Research Laboratories, Boulder, Colorado, August, 1978) a convention has been adopted by OCSEAP workers that synonymizes "nearshore" and "littoral" as we formerly used the word.

[2]Broad, A. C., *et al*., 1978. In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the year ending March, 1978. N.O.A.A. , Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. *In press*.

[3]Weller, G. *et al*., *l c*.

Table 1.1. Summary of Benthic and Related Samples made by RU356 from ALUMIAK, 1977

SUBSTRATE
St= Stones
P = Peat
S = Sand
G = Gravel
Cl= Clay
M = Mud

TRANSECT NAME	STATION NO.	POSITION N.LAT	POSITION W.LONG.	DEPTH M	BOTTOM SAL.1/100	BOTTOM TEMP.°C	NO GRAB SAMPLES	NO SEDIMENT SAMPLES	NO EPIBENTHIC DREDGE SAMPLES	NO SURFACE PLANKTON SAMPLES	SUBSTRATE
Pt. Barrow	P2D	71°23′	156°27′	2	27.0	6.0	3		1	1	G, S
	P2E	71°23′	156°27′	6	26.5	5.0	3	1			S, G
	P2F	71°25′	156°27′	10	25.0	4.3	2	1	1	1	s, c1
Cooper Island	04C	71 14	155 40	2	13.0	5.5	3	1	1	1	s
	04D	71 15	155 40	5	26.0	3.0	3	1	1	1	Cl, M, P
	04E	71 19	155 40	10	28. 1*	8.9*	3	1	1	1	M, Cl, P
Cape Simpson	N4A	71 04	154 41	5	28.5*	8.0*	3	1	1	1	M, Cl, P, St
	N4B	71 05	154 36	10	29.8*	5.5*	3	1	1	1	Cl, M
Smith Bay	N1A	70 55	154 13	5	29.0*	5.5*	3	1	1	1	M, P
	N1C	71 01	154 10	10	31. 6*	1.9*	3	1	1	1	M, P
Pitt . Point	MIE	70 55	153 15	3	30. 2*	4.9*	3	1	1	1	M, Cl, P
	M1D	70 56	153 15	5	30. 0*	4.0*	3	1	1	1	M, Cl, P
	M1C	71 00	153 15	10	31. 9*	2.1*	3	1	1	1	Cl, M, P
Cape Halkett	LIA	70 51	152 15	2	30. 7*	1.9*	1	1	1	1	cl
	L1B	70 58	152 14	5	33.9*	2.0*	1		1	1	Cl, P, M
	LØA	70 53	152 09	10	36.8*	2.2*	3	1	1	1	Cl, M, S, P
Kogru River	K4A	70 34	151 40	2	30. 5*	4.1*	3	1	1	1	M, Cl, P
	K3A	70 37	151 33	5	28.4	1.8	3	1	1	1	M, S, P
	K2A	70 39	151 27	10	28.3	0.5	3	1	1	1	M, P
Colville River	J2A	70 33	150 25	2	26.9	2.5	3	1	1	1	S, P, M
	J2B	70 33	150 25	5	27.7	2.3	3	1			M, P, Cl
	J2C	70 35	150 25	10	29.3	2.2	3	1	1	1	Cl, M, P
Pingok Island	13H	70 34	149 30	5	31.5	1.5	3	1	1	1	S, M, G
	I3G	70 34	149 30	10	33.9	1.5	3	1	1	1	Cl, M, P

Table 1.1 Continued

St= Stones
P = Peat
S = Sand
G = Gravel
Cl= Clay
M = Mud

TRANSECT NAME	STATION NO.	POSITION N.LAT	POSITION W.LONG.	DEPTH M	BOTTOM SAL.1/100	BOTTOM TEMP.°C	NO GRAB SAMPLES	NO SEDIMENT SAMPLES	NO EPIBENTHIC DREDGE SAMPLES	NO SURFACE PLANKTON SAMPLES	
Prudhoe	H3B	70 23	148 32	2	26.0	1.5	3	1	1	1	M, Cl, P
Bay	H3G	70 25	148 32	5	26.8	0.8	3	1	1	1	S, M, P
	H3H	70 30	148 32	11.5	27.2	-1.0	3	1	1	1	S, M, p
Heald	HØA	70 22	148 08	2	34. 3*	1.5*	3	1	1	1	s, P
Point	HØB	70 25	148 06	5	27.0	0.9	3	1	1	1	S, G, Sh(Shell)
	HØC	70 30	148 01	10	27.5	-1.1	3	1	1	1	M, Cl, S, P
Foggy	G3B	70 14	147 37	2	34. 2*	1.7*	3	1	1	1	S
Island	G3C	70 16	147 38	5	29.6*	6.8*	3	1	1	1	Cl, G, M, P
Bay	G3D	70 25	147 36	9			3	1	1	1	Cl, M, P
Flaxman	FØA	70 11	146 00	3	27.6	2.2	3	1			S
Island	FØB	70 12	146 00	5	31.1	1.5	3	1	1	1	s, cl, P
	FØC	70 12	146 00	10	28.0	0.5	3	1	1	1	M, S, G
Simpson	D5A	70 00	144 54	5	27.6	2.2	3	1	1	1	S, P
Cove	D5B	70 03	144 54	10	27.7	-.02	3	1	1	1	Cl, S, M, P
Hulahula	DØA	70 06	144 05	5	28.1	0.1	3	1	1	1	M, S, P
River	DØB	70 07	144 05	10	33.2	-0.2	3	1	1	1	S, M, G, P
Barter	C4F	70 08	143 41	5	28.0	0.2	3	1	1	1	S, M, P
Island	C4G	70 09	143 41	10	39. 2*	-0.5*	3	1	1	1	Cl, M, p
Tapkaurak	CIA	70 08	143 11	3.5	27.4	0.1	1	1	1	1	S,
Entrance	C1B	70 09	143 08	10	28.2	0.4	3	1	1	1	S, M,
Total Samples							125	42	41	41	

* probably instrumental error

Table 1.2. Animal species captured in bottom grabs and sled nets (see text for description of equipment) at Beaufort Sea stations between 2 and 11.5m deep from R/V ALUMIAK, 1977. Unk. after a family name or the name of a higher taxon implies unknown member(s) of that family or group. The sequence of species in the table is that of the NODC taxonomic code.

1. FORAMINIFERANS

Cornuspira sp.
Cornuspira foliacea
Cornuspira involvens
Quingueloculina sp.
Dentalina sp.
Guttulina sp.
Elphidiella sp.

2. HYDROZOANS

Perigonimus yoldia-arcticae
Calycopsis birulai
Rathkea sp.
Corymorpha flammea
Tubularia sp.
Sertularia tolli
Aglantha digitale
Aeginopsis laurentii

3. ANTHOZOANS

Eunephthya fructosa

4. NEMERTEANS

Rhynchocoela unk.

5. NEMATODES

Nematoda unk.

6. POLYCHAETA

Antinoella sarsi
Melaenis loveni
Pholoe minuta

POLYCHAETA (continued)

Spinther oniscoides
Anaitides groenlandica
Eteone longs
Nereimyra aphroditoides
Autolytus alexandri
Exogone naidina
Nephtys sp.
Nephtys ciliata
Nephtys caeca
Nephthys paradoxa
Sphaerodoropsis minuta
Lumbrinereis sp.
Lumbrinereis minuta
Schistomeringos caeca
Haploscoloplos elongatus
Scoloplos armiger
Orbinia sp.
Aricidea suecica
Cirrophorus sp.
Apistobranchus tullbergi
Prionospio cirrifera
Scolecolepides arctius
Spio filicornis
Pseudopolydora kempi
Trochochaeta carica
Cirratulidae unk.
Cirratulus cirratus
Tharyx spp.

Table , continued

Chaetozone setosa

Cossura longocirrata

Brada villosa

Diplocirrus sp.

Scalibregma inflatum

Ammotrypane (=Ophelina) cylindri-
caudatus

Travisia forbesii

Sternaspis scutata

Capitellidae unk.

Capitella capitata

Heteromastus filiformis

Mediomastus sp.

Arenicola glacialis

Praxillella praetermissa

Pectinaria (Cistenides) hyperborea

Ampharetidae unk.

Ampharete sp.

Ampharete acutifrons

Ampharete vega

Amphicteis sundevalli

Terebellidae unk.

Terebellides stroemi

Chone sp.

Euchone analis

Potamilla neglects

Laonome kroyeri

Spirorbis granulates

Dexiospira spirillum

7. OLIGOCHAETES

Enchytraeidae unk.

Tubificidae unk.

8. GASTROPOD

Margaritas sp.

Solariella varicosa

Lacuna sp.

Amauropsis purpurea

Natica sp.

Polinices sp.

Admete couthouyi

Oenopota sp.

Cylichna occults

Cylichna alba

Retusa obtusa

Limacina helicina

Clione limacina

Nudibranchia unk.

9. BIVALVES

Nucula bellotti

Portlandia arctica

Portlandia intermedia

Musculus sp.

Musculus discors

Musculus corrugates

Delectopecten greenlandicus

Axinopsida serricata

Axinopsida orbiculata

Boreacola vadosa

Astarte sp.

Astarte borealis

Cardiidae unk.

Clinocardium ciliatum

Macoma sp.

Macoma calcarea

Table , continued

Macoma moesta moesta

Macoma moesta alaskana

Macoma loveni

Liocyma fluctuosa

Mya sp.

Mya truncata

Cyrtodaria kurriana

Pandora glacialis

Lyonsia sp.

Lyonsia arenosa

Thracia sp.

Thracia myopsis

10. PYCNOGONIDS

Nymphon longitarse

11. OSTRACODS

Ostracoda unk.

12. COPEPODS

Calanoida unk.

Calanus sp.

Calanus hyperboreus

Euchaeta polaris

Augaptilus glacialis

Harpacticoida unk.

13. MYSIDS

Acanthomysis pseudomacropsis

Mysis sp. (juveniles)

Mysis litoralis

Mysis oculata

Mysis relicts

14. CUMACEANS

Lamprops sarsi

Diastylis sp.

Diastylis glabra

Diastylis nucella

Diastylis sulcata

Brachydiastylis resima

Campylaspis umbensis

15. TANAIDACEANS

Leptognatha sp.

Leptognatha gracilis

16. ISOPODS

Saduria entomon

Saduria sibirica

Saduria sabini

Munnopsis typica

17. AMPHIPODS

Amphipoda unk.

Ampelisca macrocephala

Byblis sp.

Byblis gaimardi

Haploops tubicola

Atylus carinatus

Apherusa megalops

Apherusa glacialis

Calliopius behringi

Halirages sp.

Halirages nilsoni

Corophium sp.

Rhachotropis inflata

Rozinante fragilis

Gammaridae unk. (juveniles)

Gammaracanthus loricatus

Gammarus sp. (juveniles)

Gammarus setosa

Table , continued

Gammarus zaddachi
Melita formosa
Weyprechtia pinguis
Pontoporeia femorata
Pontoporeia affinis
Priscillina armata
Hyalella sp.
Protomedeia sp.
Protomedeia stephenseni
Ischyrocerus sp.
Anonyx nugax
Boeckosimus affinis
Boeckosimus plautus
Hippomedon sp.
Onisimus sp.
Onisimus glacialis
Onisimus litoralis
Orchomene minuta
Tryphosella rusanovi
Tryphosella schneideri
Acanthostepheia behringiensis
Acanthostepheia incarinata
Aceroides latipes
Monoculodes spp.
Monoculodes packardi
Monoculopsis longicornis
Paroediceros lynceus
Paroediceros propinquus
Pleusymtes sp.
Pleusymtes karianus
Dulichia arctica
Stenothoidae unk.
Metopa sp.
Hyperia galba
Hyperoche medusarum
Parathemisto libellula

18. EUPHAUSIIDS

Thysanoessa inermis
Thysanoessa longipes
Thysanoessa raschii

19. DECAPODS

Decapoda unk.
Alpheus sp.
Eualus gaimardii belcheri
Crangon sp.
Crangon intermedia
Paguridae unk. (zoea)
Pagurus sp.
Hyas sp. (zoea)

20. CHIRONOMIDS

Chironomidae unk.

21. SIPUNCULANS

Golfingia margaritacea

22. ECHIURANS

Echiurus echiuris alaskanus

23. PRIAPULIDS

Priapulus caudatus
Halicryptus spinulosus

24. BRYOZOANS

Ectoprocta unk.
Alcyonidium disciforme
Eucratea loricata
Flustra sp.
Flustra serrulata

Table , continued

25. ASTEROIDS

Asteroidea unk.

Leptasterias arctica

26. OPHUROIDS

Ophiuroidea unk.

27. CHAETOGNATHS

Sagitta elegans

29. ASCIDIANS

Ascidiacea unk.

Pelonaia corrugata

Molgula sp.

Molgula griffithsii

Molgula retortiformis

30. LARVACEANS

Oikopleura vanhoeffeni

31. FISH

Cottidae unk.

Myoxocephalus quadricornis

Agonidae unk.

Liparis sp.

TABLE 1.3. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION CIA (70°08.1'N, 143°11.4'W, 3.5 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE . IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
	g/m^2			
POLYCHAETES		0		
OLIGOCHAETES		0		
GASTROPOD		0		
BIVALVES		0		
ISOPODS		0		
AMPHIPODS		0		
OTHER		0		
Σ		0		
	n/m^2			
POLYCHAETES		0		
OLIGOCHAETES		0		
GASTROPOD		0		
BIVALVES		0		
ISOPODS		0		
AMPHIPODS		0		
OTHER		0		
Σ		0		

TABLE 1.4. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION C1B (70°09.4'N, 143°08.4'W, 10m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	4.49	0.94	19.45	8.29	43	Nephytys caeca! Melanis loveni! Anaitides groenlandica, Terebellidae unk., Scolecolepides arctius, Prionospio cirrifera
OLIGOCHAETES	0.03	0.03		0.02	0	
GASTROPOD	0.14	0.00	3.35	1.16	6	Oenopota sp.
BIVALVES	20.54	4.37	2.47	9.13	47	Liocyma fluctuosa! Macoma loveni
ISOPODS						
AMPHIPODS	0.04	0.01	0.01	0.02	0	
OTHER	0.10		1.91	0.67	3	Molgula sp.
Σ	25.34	5.34	27.19	19.28	99	
			n/m^2			
POLYCHAETES	1219	439	1660	1106.00	59	Prionospio cirrifera, Scolecolepides arctius, Terebellides stroemi
OLIGOCHAETES	440	410		283.33	15	Enchytraidae unk!
GASTROPOD	30	20	30	26.67	1	
BIVALVES	630	60	190	293.33	16	Liocyma fluctuosa, Boreacola vadosa, Axinopsida orbiculata
ISOPODS						
AMPHIPODS	50	20	10	26.67	1	
OTHER	.210		190	133.33	7	Leptognatha gracilis
Σ	2579	949	2080	1869.33	99	

TABLE 1.5. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION C4F (70°08.3'N. 143°41.0'W, 5m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF METW EIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY INAT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	6.08	5.40	10.06	7.18	38	Ampharete vega, Scoloplos armiger, Arenicola glacialis
OLIGOCHAETES						
GASTROPOD						
BIVALVES	3.27	3.48	0.15	2.30	12	Macoma sp., Cyrtodaria kurriana
ISOPODS			22.6	7.53	40	Saduria entomon
AMPHIPODS	0.01	0.62	2.86	1.17	6	Atylus carinatus
OTHER	1.74	0.00	0.71	0.82	4	Alcyonidium disciforme
Σ	11.1	9.50	36.38	19.00	100	
			n/m^2			
POLYCHAETES	1537	1679	1932	1716.00	36	Chone sp., Prionospio cirrifera, Sphaerodoropsis minuta, Ampharete vega, Scoloplos armiger
OLIGOCHAETES						
GASTROPOD						
BIVALVES	150	140	190	160.00	8	Cyrtodaria kurriana
ISOPODS			10	3.33	0	
AMPHIPODS	40	20	250	103.33	5	Aty" us car" natus
OTHER	10	10	40	20.00	1	
Σ	1737	1849	2422	2002.66	100	

TABLE 1.6. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PERm^2 AT STATION C4G (70°09.0'N, 143°41.0'W, 10m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	15.60	0.26	4.33	6.73	33	Melanis loveni, Praxillella praetermissa, Ampharete sp.
OLIGOCHAETES			0.07	0.02	0	
GASTROPOD	0.22	0.02	0.46	0.23	1	
BIVALVES	12.14	0.19	19.66	10.66	52	Portlandia arctica, Liocyma fluctuosa Axinopsida orbiculata, Macoma loveni, Pandora glacialis
ISOPODS						
AMPHIPODS			.67	0.22	1	
OTHER	.07		8.41	2.83	14	Ascidiacea unk.
Σ	28.03	0.47	33.60	20.69	101	
			n/m^2			
POLYCHAETES	164	161	1154	493.00	53	Praxillella praetermissa, Arcidea suecica, Chaetozone setosa, Tharyx sp.
OLIGOCHAETES			50	16.67	2	
GASTROPOD	40	40	40	40.00	4	
BIVALVES	310	70	640	340.00	37	Liocyma fluctuosa, Axinopsida orbiculata
ISOPODS						
AMPHIPODS			10	3.33	0	
OTHER	10		80	30.00	3	
Σ	524	271	1974	923.00	99	

TABLE 1.7. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION DØA (70°05.7'N, 144°05.0'W, 5m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			a/m^2			
POLYCHAETES	20.46	14.69	21.42	18.86	62	Scolecolepides arctius, Prionospio cirrifera, Terebellides stroemi, Ampharete vega, Scoloplos armiger, Chone sp.
OLIGOCHAETES						
GASTROPOD						
BIVALVES	25.95	1.05	7.99	11.67	38	Cyrtodaria kurriana
ISOPODS						
AMPHIPODS	0.05			0.02	0	
OTHER	0.04		0.09	0.04	0	
Σ	46.50	15.74	29.50	30.59	100	
			n/m^2			
POLYCHAETES	3611	2457	4511	3526.33	99	Chone sp., Prionospio cirrifera, Ampharete vega, Scoloplos armiger, Sphaerodoropsis minota
OLIGOCHAETES						
GASTROPOD						
BIVALVES	20	30	20	23.33	1	
ISOPODS						
AMPHIPODS	10			3.33	0	
OTHER	10		20	10	0	
Σ	3651	2487	4551	3562.99	100	

TABLE 1.8. WET WEIGHT BIOMASS SAN NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION DØB (70°07.5'N, 144°05.0'W, 10 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	7.36	13.92	5.20	8.83	22	Anaitides groenlandica, Nephtys caeca, Melanis loveni, Travisia forbesii
OLIGOCHAETES	0.00		0.00			
GASTROPOD	2.74	1.00		1.25	3	
BIVALVES	29.49	18.22	19.52	22.41	57	Portlandia arctica, Liocyma fluctuosa Boreacola vadosa, Astarte borealis, Musculus corrugates, Macoma moesta alaskana
ISOPODS						
AMPHIPODS		.01			0	
OTHER	11.68	6.72	1.93	6.78	17	Priapulus caudatus, Ascidiacea unk, Pelonaia corrugata
Σ	51.27	39.87	26.66	39.27	99	
			n/m^2			
POLYCHAETES	529	876	686	697.00	27	Terebellides stroemi, Chaetozone setosa
OLIGOCHAETES	30		20	16.67	1	
GASTROPOD	60	60		40.00	2	
BIVALVES	2430	2390	480	1766.67	68	Liocyma fluctuosa, Boreacola vadosa
ISOPODS						
AMPHIPODS		10	10	6.67	0	
OTHER	90	150	10	83.33	3	
Σ	3139	3486	1206	2610.33	101	

TABLE 1.9. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION D5A (70°00.4'N, 144°54.4'W, 5 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	6.59	5.75	5.35	5.90	46	Orbinia sp., Ampharete vega, Chonesp. Scolecolepides arctius
OLIGOCHAETES						
GASTROPOD		0.02		0.01	0	
BIVALVES	11.99	1.87	1.29	5.05	39	Liocyma fluctuosa!
ISOPODS		4.94		1.65	13	Saduria entomon!
AMPHIPODS	0.28	0.17	0.08	0.18	1	
OTHER	0.20	0.00	0.11	0.10	1	
Σ	19.06	12.75	6.83	12.89	100	
			n/m^2			
POLYCHAETES	2691	2426	1797	2304.67	68	Orbinia sp., Prionospio cirrifera, Chone sp., Ampharete vega, Chaetozone setosa, Spio filicornis, Scolecolepides arctius
OLIGOCHAETES						
GASTROPOD		10		3.33	0	
BIVALVES	990	1020	580	863.33	26	Boreacola vadosa! Liocyma fluctuosa
ISOPODS		8		2.67	0	
AMPHIPODS	80	340	100	173.33	5	Corophium sp!
OTHER	30	10	20	20	1	
Σ	3791	3814	2497	3367.33	100	

TABLE 1.10. WETW EIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PERm^2 AT STATION D5B (70°02.8'N. 144°54.4'W, 10m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	9.58	10.11	20.53	13.41	20	Amphicteis sundevalli, Scoloplos armiger, Praxillella praetermissa, Sternaspis scutata, Anaitides groenlandica
OLIGOCHAETES	0.01	0.01		0.01	0	
GASTROPOD	0.31	1.39		0.57	1	Oenopota sp.
BIVALVES	51.87	43.38	50.60	48.62	73	Macoma calcarea! Liocyma fluctuosa, Astarte borealis, Portlandia arctica, Macoma moesta alaskana
ISOPODS		0.09		0.03	0	
AMPHIPODS	0.22	0.45	0.78	0.48	1	
OTHER	10.42	0.14	0.53	3.70	6	Golfingia margaritacea!
Σ	72.41	55.57	72.44	66.82	101	
			n/m^2			
POLYCHAETES	2849	2147	2030	2342.00	80	Cirrophorus sp., Tharyx sp., Exogone naidina, Praxillella praetermissa, Prionospio cirrifera, Chaetozone setosa
OLIGOCHAETES	50	120		56.67	2	Tubificidae!
GASTROPOD	10	20		10.00	0	
BIVALVES	110	90	100	100.00	3	
ISOPODS		10		3.33	0	
AMPHIPODS	20	30	20	23.33	1	
OTHER	370	410	390	390.00	3	Leptognatha gracilis!
Σ	3409	2827	2540	2925.33	99	

TABLE 1.11. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION FØA (70°11.5'N. 146°00.0'W, 3m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	0.24	0.04	0.1	0.13	67	
OLIGOCHAETES						
GASTROPOD						
BIVALVES						
ISOPODS						
AMPHIPODS		0.1	.07	0.06	30	
OTHER			.02	0.01	3	
Σ	0.24	0.14	0.10	0.19	100	
			n/m^2			
POLYCHAETES	69	5	10	28.00	68	
OLIGOCHAETES						
GASTROPOD						
BIVALVES						
ISOPODS						
AMPHIPODS		10	10	6.67	16	
OTHER	10		10	6.67	16	
Σ	79	15	30	41.34	100	

TABLE 1.12. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION FØB (70°11.6'N. 146°00.0'W, 5 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	8.11	5.43	2.94	5.49	51	Ampharete vega, Scolecolepides arctius, Prionospio cirrifera
OLIGOCHAETES						
GASTROPOD			0.7	0.23	2	
BIVALVES	0.24	.11		0.12	1	
ISOPODS			14.67	4.89	45	Saduria entomon
AMPHIPODS			0.01	0.00	0	
OTHER	0.27	0.03	0.07	0.12	1	
Σ	8.62	5.57	18.39	10.86	100	
			n/m^2			
POLYCHAETES	2634	2659	1760	2351	92	Ampharete vega, Chone sp., Tharyx sp., Prionospio cirrifera
OLIGOCHAETES						
GASTROPOD			10	3.33	0	
BIVALVES	20	50	10	26.67	1	
ISOPODS			10	3.33	0	
AMPHIPODS			20	6.67	0	
OTHER	380	30	100	170	7	Halicryptus spinulosus
Σ	3034	2739	1910	2561	100	

TABLE 1.13. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION FØC (70°12.4'N, 146°00.0'W, 10m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE . IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY INAT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	2.79	7.38	2.57	4.25	29	Prionospio cirrifera, Brada villosa
OLIGOCHAETES						
GASTROPOD	0.45	0.37	0.37	0.40	3	
BIVALVES	1.59	3.52	2.64	2.58	18	Macoma loveni!
ISOPODS						
AMPHIPODS	0.02	0.13	0.02	0.06	0	
OTHER	10.84	0.40	10.87	7.37	50	Anthozoa! Priapulus caudatus!
Σ	15.69	11.80	16.47	14.66	100	
			n/m^2			
POLYCHAETES	890	2121	770	1260.33	79	Nereimyra aphroditoides, Chone sp., Prionospio cirrifera, Tharyx sp. Brada villosa
OLIGOCHAETES						
GASTROPOD	130	60	60	83.33	5	
BIVALVES	100	110	80	96.67	6	
ISOPODS						
AMPHIPODS	30	30	10	23.33	1	
OTHER	50	200	140	130.0	8	Anthozoa
Σ	1200	2521	1060	1593.67	99	

TABLE 1.14. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION G3B (70°13.6'N, 147°36.8'W, 2 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	5,53	2.31	3.52	3.79	25	Orbinia sp., Travisia forbesii
OLIGOCHAETES	0.23	0.35	0.26	0.28	2	
GASTROPOD						
BIVALVES	9.04	10.35	11.33	10.24	68	Cyrtodaria kurriana!
ISOPODS						
AMPHI PODS	0.90	0.23	0.42	0.52	3	
OTHER	0.61	0.35		0.32	2	
Σ	16.31	13.60	15.53	15.14	100	
			m			
POLYCHAETES	33(I	351	420	367.00	15	Spio filicorn s, Chone sp.
OLIGOCHAETES	1360	1990	1200	1516.67	63	Enchytraeidae
GASTROPOD						
BIVALVES	210	260	230	233.33	10	Cyrtodaria kurriana!
ISOPODS						
AMPHIPODS	280	290	250	273.33	11	Priscillina armata!
OTHER	40	10		16.67	1	
Σ	2220	2901	2100	2407	100	

TABLE 1.15. WET"WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION G3C (70°16.0'N, 147°38.0'W, 5m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE . IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	3.76	3.70	5.42	4.29	41	Prionospio cirrifera, Chone sp.
OLIGOCHAETES						
GASTROPOD		0.18	0.15	0.11	1	
BIVALVES	4.70	2.93	0.32	2.65	25	Liocyma fluctuosa!
ISOPODS	4.57			1.52	15	Saduria siberica
AMPHIPODS	1.49	0.67	1.23	1.13	11	Haploops tubicola!
OTHER	0.05	0.23	1.88	0.72	7	Halicryptus spinulosus!
Σ	14.58	7.71	9.0	10.43	100	
			n/m^2			
POLYCHAETES	3811	4961	6701	5157.67	94	Sphaerodoropsis minuta, Aricidea suecica, Pionospio cirrifera, Chone sp. Tharyx sp., Lumbrinereis minuta, Cirrophorus sp.
OLIGOCHAETES						
GASTROPOD	10	10	10	10	0	
BIVALVES	50	80	130	86.67	2	
ISOPODS	40			13.33	0	
AMPHIPODS	320	100	53	157.76	3	Haploops tubicola!
OTHER	20	80	100	66.67	1	
Σ	4251	5231	6994	5492.00	100	

TABLE .16. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION G3D (70°24.8'N, 147°35.6'W, 9m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	6.22	7.54	7.17	6.98	62	Anaitides groenlandica, Praxillela praetermissa, Prionospio cirrifera
OLIGOCHAETES						
GASTROPOD	0.33	0.09	0.80	0.41	4	
BIVALVES		5.87	3.03	2.97	26	Portlandia arctica!
ISOPODS						
AMPHIPODS	0.04	1.35	0.81	0.73	6	
OTHER	0.03	0.05	0.50	0.19	2	
Σ	6.61	14.90	12.31	11.27	100	
			n/m^2			
POLYCHAETES	2194	2150	2345	2229.67	83	Ampharete acutifrons, Prionospio cirrifera Terebellides stroemi, Chone sp., Tharyx sp., Nereimyra aphroditoides, Chaetozone setosa, Diplocirrus sp.
OLIGOCHAETES						
GASTROPOD	30	20	70	40	1	
BIVALVES		30	50	26.67	1	
ISOPODS						
AMPHIPODS	70	640	90	266.67	10	Pontoporeia femorata!
OTHER	130	110	130	123.33	5	
Σ	2424	2950	2685	2686.33	100	

TABLE 1.17. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION HØA (70°22.5'N, 148°07.8'W, 2 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	4.17	6.85	3.95	4.99	41	Scolecolepides arctius, Orbinia sp! Terebellides stroemi
OLIGOCHAETES	0.01			0.00	0	
GASTROPOD						
BIVALVES		13.39	0.44	4.61	38	Portlandia arctica, Cyrtodaria kurriana
ISOPODS		6.88		2.29	19	Saduria entomon!
AMPHIPODS	0.19	0.22	0.07	0.16	1	
OTHER	0.34	0.04		0.13	1	
Σ	4.71	27.38	4.47	12.18	100	
			n/m^2			
POLYCHAETES	342	435	240	339.00	47	Orbinia sp., Spio filicornis
OLIGOCHAETES	50			16.67	2	
GASTROPOD						
BIVALVES		150	30	60.00	8	
ISOPODS		10		3.33	0	
AMPHIPODS	270	400	220	296.67	41	Pontoporeia femorata, Priscillina armata
OTHER	20	10		10.00	1	
Σ	682	1005	490	725.67	99	

TABLE 1.18. WETW EIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PERm^2 AT STATION HØB (70°24.3'N, 148°06.6'W, 5 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE . IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY INAT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	10.62	13.00	5.26	9.63	51	Anaitides groenlandica, Travisia forbesii, Scolecolepides arctius
OLIGOCHAETES						
GASTROPOD	0.23	0.01	0.03	0.09	0	
BIVALVES	12.95	2.57	9.57	8.36	44	Macoma loveni, Astarte borealis! Liocyma fluctuosa
ISOPODS						
AMPHI PODS	0.07	0.02	0.33	0.14	1	
OTHER	0.21	1.39	0.37	0.66	3	Rhynchocoela!
Σ	24.08	16.99	15.56	18.87	99	
			n/m^2			
POLYCHAETES	721	1041	770	844.00	67	Prionospio cirrifera, Scolecolepides arctius, Ampharete vega
OLIGOCHAETES						
GASTROPOD	50	20	10	26.67	2	
BIVALVES	410	190	210	270.00	21	Boreacola vadosa
ISOPODS						
AMPHIPODS	80	90	90	86.67	7	
OTHER	10	60	40	36.67	3	
Σ	1271	1401	1120	1264.00	100	

TABLE 1.19. WETW EIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION HØC (70°29.8'N., 148°01.2'W, 10 m. depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	8.82	30.55	23.43	20.93	29	Haploscoloplos elongates, Heteromastus filiformis, Praxillella praetermissa, Melanis loveni, Nephty sp., Ampharete vega, Anitoella sarsi
OLIGOCHAETES		0.01		0.00	0	
GASTROPOD	1.29	0.28	1.19	0.92	1	Natica sp!
BIVALVES	62.49	22.24	29.42	38.05	53	Portlandia arctica, Nucula bellotti, Liocyma fluctuosa, Macoma calcarea! Lyonsia arenosa, Macoma loveni, Axinopsida orbiculata
ISOPODS		1.73		0.58	1	Saduria sabini
AMPHIPODS	0.89	3.60	6.20	3.56	5	Pontoporeia femorata, Melita formosa
OTHER	0.04	7.79	17.04	8.29	11	Priapulus caudatus!
Σ	73.53	66.19	77.28	72.33	100	
			n/m^2			
POLYCHAETES	2052	1430	1844	1775.33	51	Tharyx spp., Prionospio cirrifera, Haploscoloplos elongatus, Arcidea suecica, Heteromastus filiformis
OLIGOCHAETES		20		6.67	0	
GASTROPOD	40	40	10	30.00	1	
BIVALVES	750	1270	1100	1040.00	30	Portlandia intermedia, Portlandia arctica, Axinopsida orbiculata
ISOPODS		10		3.33	0	
AMPHIPODS	130	460	900	496.67	14	Pontoporeia femorata, Melita formosa
OTHER	50	300	100	150.00	4	Leptognatha sp.
Σ	3022	3530	3954	3502	100	

TABLE 1.20. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PERm^2 AT STATION H3B (70°24.0'N. 148°32.4'W, 2 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF MET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY INAT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			a/m^2			
POLYCHAETES	5.96	9.43	6.33	7.24	29	Ampharete vega, Tharyx spp., Scolecolepides arctius
OLIGOCHAETES						
GASTROPOD						
BIVALVES	22.45	5.91	19.05	15.80	64	Cyrtodaria kurriana!
ISOPODS	1.50			0.50	2	Saduria entomon!
AMPHI PODS	0.59	0.18	0.13	0.30	1	
OTHER	0.71	0.03	2.09	0.94	4	Diastylis sulcata!
Σ	31.21	15.55	27.60	24.87	100	
			n/m^2			
POLYCHAETES	1254	2292		1482	80	Scolecolepides arctius, Ampharete vega, Tharyx spp., Prionospio cirrifera, Eteone longs
OLIGOCHAETES						
GASTROPOD						
BIVALVES	100	70	50	76.67	4	
ISOPODS	10			3.33	0	
AMPHIPODS	190	190	150	176.67	8	Pontoporeia femorata
OTHER	50	10	440	166.67	8	Diastylus sulcata!
Σ	1614	2562	2122	2099.33	100	

TABLE 1.21. MET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION H3G (70°25.7'N, 148°32.4'W, 5 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	2.69	22.54	30.36	18.53	91	Ampharete vega! Scolecolepides arctius
OLIGOCHAETES						
GASTROPOD						
BIVALVES	1.41	0.03	0.10	0.51	3	Liocyma fluctuosa!
ISOPODS						
AMPHIPODS	0.01	0.03	0.02	0.02	0	
OTHER		0.14	3.60	1.25	6	Molgula griffithsii
Σ	4.11	22.74	34.08	20.31	100	
			n/m^2			
POLYCHAETES	665	1362	1592	1206.33	96	Prionospio cirrifera, Chone sp. Ampharete vega
OLIGOCHAETES						
GASTROPOD						
BIVALVES	30	10	20	20.00	2	
ISOPODS						
AMPHIPODS	40	20	30	30.00	2	
OTHER		10	10	6.67	1	
Σ	735	1402	1652	1263.00	101	

TABLE 1.22. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION H3H (70°30.2'N, 148°32.4'W, 11 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	7.18	4.96	3.95	5.36	32	Nephtys ciliata, Praxillella praetermissa, Nephtys sp.
OLIGOCHAETES						
GASTROPOD	0.15	0.64	0.28	0.36	2	
BIVALVES	13.68	12.43	0.00	8.70	53	Portlandia arctica!
ISOPODS						
AMPHIPODS	0.01	0.01	0.00	0.01	0	
OTHER	3.39	2.12	0.70	2.07	13	Ascidiacea!
Σ	24.41	20.16	4.93	16.50	100	
			n/m^2			
POLYCHAETES	1037	304	801	714.00	78	Diplocirrus sp., Prionospio cirrifera
OLIGOCHAETES						
GASTROPOD	30	50	20	33.33	4	
BIVALVES	160	80	30	90.00	10	
ISOPODS						
AMPHIPODS	10	10	10	10.00	1	
OTHER	90	40	60	63.33	7	
Σ	1327	484	921	910.67	100	

TABLE 1.23. WETW EIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PERm^2 AT STATION I3G (70"34.5'N, 149°30.0'W, 10 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE . IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY INAT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	4.87	9.32	9.04	7.74	42	Prionospio cirrifera, Ampharete vega
OLIGOCHAETES		0.00	0.01		0	
GASTROPOD	0.11	0.70		0.27	1	
BIVALVES	5.00	3.36	9.62	5.99	33	Portlandia arctica, Portlandia intermedia
ISOPODS		8.05		2.68	15	Saduria entomon!
AMPHIPODS	2.41	0.01	0.92	1.11	6	Boekosimus affinis
OTHER	0.67	0.20	0.65	0.51	3	
Σ	13.06	21.63	20.24	18.31	100	
			n/m^2			
POLYCHAETES	4915	7993	5798	6235.33	84	Prionospio cirrifera, Cossura longocirrata, Chone sp., Sphaerodoropsis minuta, Tharyx sp., Trochochaeta carica
OLIGOCHAETES		10	20	10.00	0	
GASTROPOD	10	120		43.33	1	
BIVALVES	720	650	1240	870.00	12	Portlandia arctica, Portlanda intermedia, Axinopsida orbiculata
ISOPODS		10		3.33	0	
AMPHIPODS	220	20	30	90.00	1	Boekosimus affinis
OTHER	400	40	100	180.00	2	Rhynchocoela, Diastylis sulcata
Σ	6265	8843	7188	7432.00	100	

TABLE 1.24. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION 13H (70°33.8'N, 149°30.0'W, 5 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			a/m^2			
POLYCHAETES	3.03	0.48	4.56	2.69	9	Scolecolepides arctius, Ampharete vega
OLIGOCHAETES						
GASTROPOD		0.01		0.00	0	
BIVALVES						
ISOPODS		76.18		25.39	88	Saduria entomon!
AMPHIPODS	0.00	0.01	0.04	0.02	0	
OTHER	0.02	0.02	2.00	0.68	2	Molgula griffithsii
Σ	3.05	76.68	6.60	28.78	99	
			n/m^2			
POLYCHAETES	194	107	230	177.00	72	Prionospio cirrifera
OLIGOCHAETES						
GASTROPOD		10		3.33	1	
BIVALVES						
ISOPODS		10		3.33	1	
AMPHIPODS	10	20	20	16.67	7	
OTHER	20	30	90	46.67	19	
Σ	224	177	340	247.00	100	

TABLE 1.25. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION J2A (70°32.7'N, 150°25.0'W, 2 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	0.09	0.22	0.78	0.36	73	
OLIGOCHAETES	0.04	0.08	0.02	0.05	9	
GASTROPOD						
BIVALVES						
ISOPODS						
AMPHIPODS		0.02		0.01	1	
OTHER	0.08	0.17	0.00	0.08	17	
Σ	0.21	0.49	0.80	0.50	100	
			n/m^2			
POLYCHAETES	110	100	264	158.00	26	*Scolecolepides arctiuis!*
OLIGOCHAETES	450	520	350	440.00	72	Enchytraidae!
GASTROPOD						
BIVALVES						
ISOPODS						
AMPHIPODS		10		3.33	1	
OTHER	20	10	10	13.33	2	
Σ	580	640	624	614.67	101	

MACROBENTHONIC WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF ANIMALS PER m^2 AT STATION J2B (70°33.5'N 150°25.0'W, 5m depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	20.15	27.18	17.09	21.47	54	Prionospio cirrifera, Scolecolepides arctius, Terebellides stroemii
OLIGOCHAETES			0.01	0.00	0	
GASTROPOD						
BIVALVES	16.49	3.68	14.33	11.50	29	Portlandia arctica, Cyrtodaria kurriana
ISOPODS	0.69		17.97	6.22	16	Saduria entomon!
AMPHIPODS	0.38	0.36	0.09	0.28	1	
OTHER	0.11	0.81	0.04	0.32	1	
Σ	37.82	32.03	49.53	39.79	101	
			n/m^2			
POLYCHAETES	3935	4839	2472	3838.67	96	Prionospio cirrifera, Scolecolepides arctius, Chone sp., Terebellides stroemi, Tharyx sp.
OLIGOCHAETES			40	13.33	0	
GASTROPOD						
BIVALVES	60	80	90	76.67	2	
ISOPODS	10		10	6.67	0	
AMPHIPODS	40	60	20	40.00	1	
OTHER	40	30	40	36.67	1	
Σ	4085	5009	2942	4012.00	100	

TABLE 1.27. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION J2C (70° 35.5'N, 150°25.0'W, 10 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	3.80	3.35	2.77	3.31	11	Prionospio cirrifera
OLIGOCHAETES						
GASTROPOD	1.26	0.15	0.18	0.53	2	Oenopota sp!
BIVALVES	35.93	12.78	19.62	22.78	78	Portlandia intermedia, Portlandia arctica!
ISOPODS	5.35	0.13	0.14	1.87	6	Saduria sabini
AMPHIPODS	0.56	1.23	0.02	0.60	2	Boekosimus affinis
OTHER		0.88		0.29	1	
Σ	46.90	18.52	22.73	29.38	100	
			n/m^2			
POLYCHAETES	2735	4200	2054	2996.33	62	Chone sp., Tharyx spp., Prionospio cirrifera
OLIGOCHAETES	120	50	10	60.00	1	Oenopota sp!
GASTROPOD	2140	1310	590	1346.67	28	Portlandia intermedia, Axinopsida orbiculata, Portlandia arctica
BIVALVES						
ISOPODS	20	10	10	13.33	0	
AMPHIPODS	60	10	10	26.67	1	
OTHER		1090		363.33	8	Ascidiacea!
Σ	5075	6670	2674	4806.33	100	

TABLE 1.28. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION K2A (70°39.2'N, 151°27.2'W, 10m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	11.31	9.46	17.56	12.78	53	Sternaspis scutata, Prionospio cirrifera, Scolecolepides arctius
OLIGOCHAETES						
GASTROPOD	0.14	0.05	0.08	0.09	0	
BIVALVES	2.15	8.41	23.18	11.25	46	Portlandia arctica! Macoma calcarea
ISOPODS						
AMPHIPODS	0.00	0.17	0.40	0.19	1	
OTHER	0.04		0.07	0.04	0	
Σ	13.64	18.09	41.29	24.34	100	
			n/m^2			
POLYCHAETES	3977	3977	4664	4206.00	81	Prionospio cirrifera! Chone sp.
OLIGOCHAETES						
GASTROPOD	60	20	20	33.33	1	
BIVALVES	210	660	1910	926.67	18	Portlandia arctica! Portlandia intermedia
ISOPODS						
AMPHIPODS	3	10	60	24.33	0	
OTHER	20		10	10.00	0	
Σ	4270	4667	6664	5200.33	100	

TABLE 1.29. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION K3A (70°36.7'N, 151°33.5'W, 5m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	9.38	14.55	4.70	9.54	18	Scolecolepides arctius, Prionospio cirrifera
OLIGOCHAETES						
GASTROPOD	0.01		0.95	0.32	1	
BIVALVES	5.43	0.14	3.49	3.02	6	Portlandia arctica!
ISOPODS	56.73	66.85		41.19	76	Saduria entomon!
AMPHI PODS			0.06	0.02	0	
OTHER	0.15	0.44	0.37	0.32	1	
Σ	71.70	81.97	9.57	54.41	102	
			n/m^2			
POLYCHAETES	3057	3250	2187	2831.33	83	Chaetozone setosa, Ampharete vega, Scolecolepides arctius, Prionospio cirrifera, Tharyx sp., Chone sp.
OLIGOCHAETES						
GASTROPOD	10		60	23.33	1	
BIVALVES	180	180	1070	476.67	14	Axinopsida serricata! Portlandia arctica, Boreacola vadosa
ISOPODS	100	10		36.67	1	Saduria entomon!
AMPHIPODS			60	20.00	1	
OTHER	40	20	60	40.00	1	
Σ	3387	3460	3437	3428.00	101	

TABLE 1.30. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION K4A (70°34.0'N, 151°40.1'W, 2 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	37.98	34.72	17.05	29.92	49	Ampharete vega, Tharyx sp., Scolecolepides arctius, Terebellides stroemi
OLIGOCHAETES	0.65	1.03	0.13	0.60	1	Tubificidae!
GASTROPOD						
BIVALVES	29.63	31.39	19.61	26.88	44	Cyrtodaria kurriana!
ISOPODS	0.13	1.40	0.48	0.67	1	Saduria entomon!
AMPHIPODS	0.74	0.54	0.46	0.58	1	
OTHER	4.59	0.87	0.96	2.14	4	Halicryptus spinulosus!
Σ	73.72	69.95	38.69	60.79	100	
			n/m^2			
POLYCHAETES	16,885	15,061	9,597	13,847.67	86	Tharyx sp! Ampharete vega, Scolecolepides arctius, Chone sp.
OLIGOCHAETES	1,620	3,000	480	1,700.00	11	tubificidae!
GASTROPOD						
BIVALVES	170	260	200	210.00	1	Cyrtodaria kurriana!
ISOPODS	10	30	30	23.00	0	
AMPHIPODS	190	160	170	173.33	1	Pontoporeia femorata!
OTHER	180	180	290	216.67	1	Halicryptus spinulosus! Diastylis sulcata
Σ	19,055	18,691	10,767	16,171.00	100	

TABLE 1.31. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION LØA (70°53.5'N, 152°08.7'W, 10m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF MET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE . IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	8.18	14.50	11.10	11.26	38	Sternaspis scutata, Praxillella praetermissa, Prionospio cirrifera, Nephtys caeca
OLIGOCHAETES						
GASTROPOD			0.07	0.02	0	
BIVALVES	4.29	2.66	21.67	9.54	33	Portlandia arctica! Macoma calcarea!
ISOPODS		6.59	0.94	2.51	9	Saduria sabini
AMPHI PODS	1.44	1.36	1.52	1.44	5	Pontoporeia femorata
OTHER		0.42	13.32	4.58	16	Priapulus caudatus!
Σ	13.91	25.53	48.62	29.35	101	
			n/m^2			
POLYCHAETES	2456	3099	3521	3025.33	84	Chone sp., Prionospio cirrifera! Capitella capitata, Cossura longocirrata
OLIGOCHAETES						
GASTROPOD			10	3.33	0	
BIVALVES	450	230	410	363.33	10	Portlandia arctica! Axinopsida orbiculata
ISOPODS		10	10	6.67	0	
AMPHIPODS	130	250	150	176.67	5	Melita formosa, Pontoporeia femorata
OTHER		20	30	16.67	0	
Σ	3036	3609	4131	3592.00	99	

TABLE 1,32. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PERm^2 AT STATION LIA (70°50.8'N, 152°15.5'W, 2 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER log OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
	g/m^2			
POLYCHAETES	1.37	1.37	20	
OLIGOCHAETES				
GASTROPOD				
BIVALVES				
ISOPODS	5.22	5.22	77	Saduria entomon
AMPHIPODS	0.08	0.08	1	
OTHER	0.12	0.12	2	
Σ	6.79	6.79	100	
	n/m^2			
POLYCHAETES	427	427.00	74	
OLIGOCHAETES				
GASTROPOD				
BIVALVES				
ISOPODS	30	30.00	5	
AMPHIPODS	100	100.00	17	
OTHER	20	20.00	3	
Σ	577	577.00	99	

TABLE 1.33. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION LIB (70°51.3'N, 152°14.0'W, 5 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE . IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
	g/m^2			
POLYCHAETES	7.87	7.87	56	Prionospio cirrifera
OLIGOCHAETES				
GASTROPOD				
BIVALVES	5.30	5.30	38	Portlandia arctica
ISOPODS				
AMPHIPODS	0.44	0.44	3	
OTHER	0.41	0.41	3	
Σ	14.02	14.02	100	
	n/m^2			
POLYCHAETES	3344	3344.00	80	Sphaerodoropsis minuta, Nereimyra aphroditoides, Spio filicornis, Tharyx spp., Prionospio cirrifera
OLIGOCHAETES				
GASTROPOD				
BIVALVES	290	290.00	7	Portlandia intermedia
ISOPODS				
AMPHIPODS	70	70.00	2	
OTHER	480	480.00	11	Rhynchocoela
Σ	4184	4184.00	100	

TABLE 1.34. MET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION M1C (71°00.0'N, 153°15.3'W, 10m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WETW EIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
		g/m^2				
POLYCHAETES	2.75	3.91	12.73	6.46	33	Prionospio cirrifera, Sternaspis scutata, Praxillella praetermissa, Terebellides stroemi
OLIGOCHAETES	0.77		0.36	0.38	2	
GASTROPOD	0.05		0.01	0.02	0	
BIVALVES	4.54	9.39	3.26	5.73	29	Portlandia arctica! Macoma loveni
ISOPODS	5.39		9.19	4.86	25	Saduria siberica, Saduria sabini!
AMPHIPODS	4.97	0.27	0.58	1.94	10	Melita formosa!
OTHER		0.33		0.11	1	
Σ	18.47	13.90	26.13	19.50	100	
		n/m^2				
POLYCHAETES	2640	1025	1566	1743.67	58	Cirrophorus sp., Cossura longocirrata, Prionospio cirrifera, Capitella capitata, Chone sp.
OLIGOCHAETES	810		750	520.00	17	Tubificidae!
GASTROPOD	10	10	10	10	0	
BIVALVES	420	790	380	530.00	17	Portlandia arctica! Portlandia intermedia
ISOPODS	30		40	23.33	1	
AMPHIPODS	460	70	70	200.00	7	Melita formosa!
OTHER		10		3.33	0	
Σ	4370	1905	2816	3030.33	100	

TABLE 1.35. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION MID (70°56.6'N, 153°15.3'W, 5m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2		
POLYCHAETES	10.49	14.18	12.34	8	Terebellides stroemi, Scoloplos armiger, Ampharete vega, Ampharete acutifrons
OLIGOCHAETES					
GASTROPOD	0.31		0.16	0	
BIVALVES	46.99	49.26	48.13	30	Cyrtodaria kurriana, Portlandia arctica, Liocyma fluctuosa, Axinopsida orbiculata, Boreacola vadosa, Macoma loveni, Portlandia intermedia
ISOPODS	193.34		96.67	61	Saduria entomon!
AMPHIPODS	0.09		0.05	0	
OTHER	0.23	0.81	0.52	0	
Σ	251.45	64.25	157.87	99	
			n/m^2		
POLYCHAETES	3302	3184	3243.00	37	Prionospio cirrifera, Spio filicornis, Chone sp., Ampharete vega, Terebellides stroemi, Scoloplos armiger, Eteone longa Ampharete acutifrons
OLIGOCHAETES					
GASTROPOD	30		15.00	0	
BIVALVES	9140	1430	5285.00	60	Portlandia arctica, Liocyma fluctuosa, Axinopsia orbiculata, Boreacola vadosa, Macoma loveni, Cyrtudaria kurriana
ISOPODS	40		20.00	0	
AMPHIPODS	10		5.00	0	
OTHER	380	30	205.00	2	Harpacticoida!
Σ	12902	4644	8773.00	99	

TABLE 1.36. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION M1E (70°55.3'N, 153°15.3'W, 3m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	18.93	21.01	25.09	21.68	46	Scolecolepides arctius, Ampharete vega, Scoloplos armiger, Terebellides stroemi
OLIGOCHAETES						
GASTROPOD	1.79	3.39	1.79	2.32	5	Admete couthouyi, Natica sp., Oenopota Sp.
BIVALVES	18.24	28.91	12.00	19.72	42	Portlandia arctica, Boreacola vadosa, Liocyma fluctuosa, Portlandia intermedia, Cyrtodaria kurriana
ISOPODS						
AMPHIPODS	0.03	2.42	3.43	1.96	4	Atylus carinatus, Acanthostepheia behringiensis
OTHER	2.95	0.75	0.04	1.25	3	Rhynchocoela!
Σ	41.94	56.48	42.35	46.93	100	
			n/m^2			
POLYCHAETES	2384	4306	2535	3075.00	63	Sphaerodoropsis minuta, Prionospio cirrifera, Chone sp., Ampharete vega, Scoloplos armiger, Spio filicornis, Capitella capitata, Terebellides stroemi, Eteone longs
OLIGOCHAETES						
GASTROPOD	110	110	80	100.00	2	
BIVALVES	1480	2600	750	1610.00	33	Boreacola vadosa, Liocyma fluctuosa Portlandia intermedia
ISOPODS						
AMPHIPODS	20	80	90	63.33	1	
OTHER	40	100	10	50.00	1	
Σ	4034	7196	3465	4898.33	100	

TABLE 1.37. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION NIA (70°55.2'N, 154°13.5'W, 5m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	1.53	14.89	1.59	6.00	10	Prionospio cirrifera, Melanis loveni
OLIGOCHAETES			0.00	0.00	0	
GASTROPOD	0.15	5.80	0.47	2.14	4	Natica sp!
BIVALVES	28.63	65.37	37.07	43.69	72	Portlandia intermedia, Macoma loveni Portlandia arctica, Astarte borealis Liocyma fluctuosa
ISOPODS	23.67	0.10		7.92	13	Saduria sabini!
AMPHIPODS		0.01	1.85	0.62	1	Atylus carinatus!
OTHER	0.01	0.53	0.16	0.23	0	
Σ	53.99	86.70	41.14	60.60	100	
			n/m^2			
POLYCHAETES	682	2482	1304	1489.33	39	Ampharete vega, Prionospio cirrifera, Tharyx sp., Chone sp., Terebellides stroemi, Spio filicornis, Cirratulidae, Sphaerodoropsis minuta
OLIGOCHAETES			30	10.00	0	
GASTROPOD	40	110	10	53.33	1	
BIVALVES	1870	2220	2220	2103.33	54	Portlandia intermedia, Portlandia arctica, Axinopsida orbiculata, Liocyma fluctuosa, Boreacola vadosa
ISOPODS	10	10		6.67	0	
AMPHIPODS		20	20	13.33	0	
OTHER	10	540	20	190.00	5	Halicryptus spinulosus
Σ	2612	5382	3604	3866.00	99	

TABLE 1.38. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION N1C (71°00.6'N, 154°10.5'W, 10 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1 m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	6.33	82.03	91.05	59.80	47	Nephtys ciliata, Sternaspis scutata! Terebellidae unk., Terebellides stroemi, Ammotrypane cylindricaudatus, Prionospio cirrifera
OLIGOCHAETES						
GASTROPOD	1.46	4.03		1.83	1	Natica sp!
BIVALVES	39.90	48.07	21.39	36.45	28	Portlandia arctica, Portlandia intermedia, Macoma calcarea, Liocyma fluctuosa, Macoma loveni
ISOPODS	30.38	52.79	1.01	28.06	22	Saduria sabini!
AMPHIPODS	1.54	2.04	1.93	1.84	1	Pontoporeia femorata!
OTHER	0.11		0.01	0.04	0	
Σ	79.72	188.96	115.39	128.02	99	
			n/m^2			
POLYCHAETES	1612	1401	2286	1766.33	39	Nephtys paradoxical Prionospio cirrifera, Cossura longocirrata, Aricidea suecica, Cirrophorus sp., Sternaspis scutata
OLIGOCHAETES						
GASTROPOD	60	140		66.67	1	
BIVALVES	2230	2750	1580	2186.67	48	Portlandia intermedia, Portlandia arctica, Macoma moesta
ISOPODS	40	40	20	33.33	1	
AMPHIPODS	500	500	470	490.00	11	Pontoporeia femorata!
OTHER	30		20	16.67	0	
Σ	4472	4831	4376	4559.67	100	

TABLE 1.39. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION N4A (71°04.0'N, 154°41.5'W, 5 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PERm^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	4.50	9.84	6.71	7.02	32	Ampharete acutifrons, Melanis loveni, Scoloplos armiger
OLIGOCHAETES						
GASTROPOD						
BIVALVES	15.02	19.13	6.40	13.52	62	Portlandia arctica!
ISOPODS						
AMPHIPODS	0.08	0.19	1.69	0.65	3	Boeckosimus affinis
OTHER	1.30	0.81	0.04	0.72	3	Echiurus echiurus alaskensis
Σ	20.90	29.97	14.84	21.91	100	
			n/m^2			
POLYCHAETES	1090	1742	1215	1349.00	76	Chone sp., Prionospio cirrifera, Tharyx sp., Cirrophorus sp.
OLIGOCHAETES						
GASTROPOD						
BIVALVES	300	340	130	256.67	15	Portlandia arctica!
ISOPODS						
AMPHIPODS	40	50	60	50.00	3	
OTHER	20	30	290	113.33	6	Rhynchocoela!
Σ	1450	2162	1695	1769.00	100	

TABLE 1.40. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION N4B (71°05.5'N, 154°35.7'W, 10 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	40.12	10.81	0.14	17.02	29	Sternaspis scutata! Terebellidae
OLIGOCHAETES						
GASTROPOD	0.28	0.13		0.14	0	
BIVALVES	5.42	75.20	34.31	38.31	66	Portlandia arctica! Lyonsia arenosa Macoma calcarea
ISOPODS			5.88	1.96	3	Saduria siberica!
AMPHIPODS		0.93	1.77	0.90	2	Protomedia stephenseni
OTHER		0.10	0.14	0.08	0	
Σ	45.82	87.17	42.24	58.41	100	
			n/m^2			
POLYCHAETES	1224	1015	274	837.67	42	Sternaspis scutata, Cossura longocirrata, Cirrophorus sp., Arcidea suecica
OLIGOCHAETES						
GASTROPOD	20	90		36.67	2	
BIVALVES	370	1810	740	973.33	49	Portlandia arctica, Portlandia intermedia
ISOPODS			40	13.33	1	
AMPHIPODS		60	80	46.67	2	
OTHER		160	30	63.33	3	Rhynchocoela!
Σ	1614	3135	1164	1971.00	99	

TABLE 1.41. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION 04C (71°14.3'N, 155°40.5'W, 2 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	0.64	0.51	0.21	0.45	25	
OLIGOCHAETES		0.01			0	
GASTROPOD						
BIVALVES	0.02	0.05		0.02	1	
ISOPODS						
AMPHI PODS	0.09	0.03	0.01	0.04	2	
OTHER		1.57	2.27	1.28	71	Rhynchocoela!
Σ	0.74	2.17	2.50	1.80	99	
			n/m^2			
POLYCHAETES	900	510	260	556.65	75	Spio filicornis!
OLIGOCHAETES		100		33.33	5	Enchytraeidae!
GASTROPOD						
BIVALVES	30	20		16.67	2	
ISOPODS						
AMPHIPODS	140	40	20	66.67	9	Monoculopsis longicornis
OTHER		20	180	66.67	9	Rhynchocoela!
Σ	1070	690	460	740.00	100	

TABLE 1.42. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION 04D (71°14.7'N, 155°40.5'W, 5 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WETW EIGHT B1OMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	SAMPLE B	SAMPLE C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	5.86	21.99	2.17	10.01	59	Scoloplos armiger, Terebell ides stroemi, Arenicola glacial is! Nephtys caeca
01 IGOCHAETES						
GASTROPOD						
BIVALVES	3.17	11.33	1.22	5.24	31	Portlandia arctica!
ISOPODS						
AMPHIPODS		2.90	1.74	1.55	9	Acanthostepheia behringiensis, Boekosimus affinis!
OTHER	0.07	0.03	0.10	0.07	0	
Σ	9.10	36.25	5.23	16.87	99	
			n/m^2			
POLYCHAETES	1390	2611	1609	1870.00	86	Terebellides stroemi, Chone sp., Prionospio cirrifera, Spio filicornis
OLIGOCHAETES						
GASTROPOD						
BIVALVES	230	550	50	276.67	13	Portlandia arctica, Axinopsida orbiculata
ISOPODS						
AMPHIPODS		50	20	23.33	1	
OTHER	20	20	10	16.67	1	
Σ	1640	3231	1689	2186.67	101	

TABLE 1.43. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION 04E (71°17.2'N, 155°40.5'W, 10 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1 m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	14.53	3.90	4.62	7.68	16	Chone sp., Nephtys caeca, Terebellidae
OLIGOCHAETES	0.10	0.02	0.07	0.06	0	
GASTROPOD	0.16	0.13	0.03	0.11	0	
BIVALVES	9.51	8.55	5.70	7.92	16	Portlandia arctica, Macoma calcarea, Lyonsia arenosa
ISOPODS		99.13		33.04	67	Saduria entomon!
AMPHIPODS	0.03	0.25	0.93	0.40	1	
OTHER	0.76	0.05	0.07	0.29	1	
Σ	25.08	112.03	11.41	49.50	101	
			n/m^2			
POLYCHAETES	5675	2981	2896	3850.67	80	Aricidea suecica, Cossura longocirrata, Chone sp., Chaetozone setosa, Spio filicornis, Nephtys paradoxa, Tharyx sp., Cirrophorus sp.
OLIGOCHAETES	290	240	270	266.67	6	Tubificidae!
GASTROPOD	10	10	10	10.00	0	
BIVALVES	300	610	270	393.33	8	Portlandia arctica, Macoma calcarea, Macoma loveni
ISOPODS		11		3.67	0	
AMPHIPODS	30	460	190	226.67	5	Pontoporeia femorata!
OTHER	50	80	30	53.33	1	
Σ	6355	4392	3666	4804.33	100	

TABLE 1.44. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION P2D (71°23.3'N, 156°27.1'W, 2 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES		0.04		0.01	1	
OLIGOCHAETES						
GASTROPOD						
BIVALVES						
ISOPODS						
AMPHI PODS	0.31	0.10	0.00	0.14	13	
OTHER	1.60	0.26	0.92	0.92	86	Rhynchocoela!
Σ	1.90	0.40	0.92	1.07	100	
			n/m^2			
POLYCHAETES		21		7.00	0	
OLIGOCHAETES						
GASTROPOD						
BIVALVES						
ISOPODS						
AMPHIPODS	285	30	10	108.33	1	Gammarus zaddachi
OTHER	35041	2130	10360	15843.67	99	Rhynchocoela!
Σ	35326	2181	10370	15959.00	100	

TABLE 1.45. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION P2E (71°23.4'N, 156°27.0'W, 6 m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF 0.1 m^2 SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	2.80	2.14	0.91	1.95	36	Nephtys ciliata
OLIGOCHAETES		0.11		0.04	1	
GASTROPOD	0.38		0.08	0.15	3	
BIVALVES	1.44	0.11	0.36	0.64	12	Clinocardium ciliatum
ISOPODS			3.84	1.28	23	Saduria entomon!
AMPHIPODS	0.00	2.97		0.99	18	Acanthostepheia behringiensis
OTHER	1.25			0.42	8	Rhynchocoela!
Σ	5.87	5.33	5.19	5.47	101	
			n/m^2			
POLYCHAETES	317	271	226	271.33	66	Nephtys ciliata
OLIGOCHAETES		130		43.33	11	Tubificidae!
GASTROPOD	20		10	10.00	2	
BIVALVES	70	40	70	60.00	15	
ISOPODS			10	3.33	1	
AMPHIPODS	10	50		20.00	5	
OTHER	10			3.33	1	
Σ	427	491	316	411.33	101	

TABLE 1.46. WET WEIGHT BIOMASS AND NUMBER OF INDIVIDUALS OF SIX CATEGORIES OF MACROBENTHONIC ANIMALS PER m^2 AT STATION P2F (71°25.8'N, 156°27.2'W, 10m, depth) IN AUGUST, 1977. DATA ARE DERIVED FROM CATCH OF $0.1m^2$ SMITH-MCINTYRE GRAB SCREENED THROUGH 0.423mm NITEX. PRINCIPAL SPECIES ARE THOSE REPRESENTED BY EITHER 1.0g OF WET WEIGHT BIOMASS OR 100 INDIVIDUALS PER m^2 IN AT LEAST ONE SAMPLE. IF FOLLOWED BY !, THE SPECIES ACCOUNTED FOR VIRTUALLY ALL OF THE NUMBER OR MASS OF THAT TAXONOMIC CATEGORY IN AT LEAST ONE SAMPLE.

TAXONOMIC CATEGORY	SAMPLE A	B	C	$\bar{X}$	% OF TOTAL	PRINCIPAL SPECIES
			g/m^2			
POLYCHAETES	4.61	0.25	0.03	1.63	66	Pectinaria (Cystenides) hyperborea, Anaitides groenlandica
OLIGOCHAETES		0.01			0	
GASTROPOD			0.06	0.02	1	
BIVALVES	1.30	0.02		0.44	18	Thracia sp.
ISOPODS						
AMPHIPODS	0.01	0.72	0.39	0.37	15	
OTHER						
Σ	5.92	1.00	0.48	2.47	100	
			n/m^2			
POLYCHAETES	602	80	4	228.67	90	Prionospio cirrifera, Pectinaria (Cystenides) hyperborea
OLIGOCHAETES		10		3.33	1	
GASTROPODS			20	6.67	3	
BIVALVES	10	10		6.67	3	
ISOPODS						
AMPHIPODS	10	10	10	10.00	4	
OTHER						
Σ	622	110	34	255.33	101	

TABLE 1.47: Catch of epibenthic sled net at several Beaufort Sea stations in 1977. See text for discussion of net and technique. Locations of stations are given in tables 1.3 to 1.46. Data are standardized for a 50 m tow and are comparable to sled net data reported previously by RU-356, but should not be used in direct comparison to data from bottom grabs. Wet weight biomass in grams appears in columns g and numbers of animals in columns n.

STATION	CIA		C1B		C4E		C4G		DØA		DØB		D5A	
	g	n	g	n	g	n	g	n	g	n	g	n	g	n
ALL ANIMALS	6.33	2834	8.64	240	12.24	2508	1.42	139	19.24	274	0.32	12	9.33	754.
Mysis littorals	1.63	618	7.86	157	1.88	206	0.51	16	0.50	62	0.12	3	4.83	674
Mysis relicts	3.81	1441												
Saduria entomon					9.03	1			18.27	4			4.25	1
Calanus hyperboreus	0.37	657			1.02	2274	0.11	80	0.33	201			0.11	61
Thysanoessa raschii							0.47	12						
Amphipods and other crustacea	0.49	113	0.58	20	0.19	21	0.16	5			0.05	2	0.09	8
See footnote			0.02[1]	49[1]							0.13[2]	1[2]		
% of total	99	99	98	94	99	99	88	81	99	97	94	50	99	99

Table 1.47, continued

STATION	D5B		FØB		FQC		G3B		G3C		G3D		HØA	
	g	n	g	n	g	n	g	n	g	n	g	n	g	n
ALL ANIMALS	1.28	89	17.58	376	1.80	87	0.82	251	3.66	456	2.69[5]	101[5]	24.31	4124
Mys is littorals	0.23	27	6.34	183	0.12	29	0.27	87	1.84	250			21.57	3354
Mys is relicts							0.30	49						
Saduri a entomon			7.54	3					0.85	1				
Calanus hyperboreus			0.10	129					0.12	167			0.34	295
Thysanoessa raschii	0.31	7	0.40	8										
Amphipods and other crustacea	0.12	7	1.97	49	1.33	39	0.18	57	0.02	17	0.34	58	0.26	45
See footnote	0.21[3]	40[3]	1.18[4]	1[4]			0.06[1]	50[1]			1.31[6]	2[6]	1.36[7]	314[7]
% of total	68	91	99	99	81	78	99	97	77	95	61	59	97	97

Table 1.47, continued

STATION	HØB		HØC		H3B		H3G		H3H		I3H		J2A	
	g	n	g	n	g	n	g	n	g	n	g	n	g	n
ALL ANIMALS	0.17	42	1.07	112	90.79	8420	14.69	152	0.36	49	16.40	1113	3.42	382
Mysis littorals					9.43	993					9.46	999	1.88	84
Mysis rel icta					63.11	6645								
Saduria entomon					12.99	16	12.83	9			5.89	2		
Calanus hyperboreus			0.15	58					0.03	10			0.32	202
Thysanoessa raschii														
Amphipods and other crustacea	0.13	31	0.12	36	2.10	47	0.66	68	0.30	30	0.69	84	0.77	69
See footnote			0.30[8]	21[8]	2.90[9]	632[9]	1.16[10]	64[10]						
% of total	76	74	53	94	99	99	99	93	92	82	98	97	87	93

Table 1.47, continued

STATION	J2C g	J2C n	K3A g	K3A n	K4A g	K4A n	LØA g	LØA n	LIA g	LIA n	L1B g	L1B n	M1C g	M1C n
ALL ANIMALS	1.06	221	1.95	212	5.19	648	3.85	325	5.74	734	7.93	502	1.03	153
Mysis littorals	0.18	5	1.14	132	1.93	198	1.48	157	3.85	465	2.24	150		
Mysis relieta					1.13	117			0.58	70	0.56	38		
Saduria entomon											2.79	1		
Calanus hyperboreus	0.50	171	0.17	33					0.10	79				
Thysanoessa raschii														
Amphipods and other crustacea	0.09	7	0.02	4	0.10	38	0.45	30	1.09	113	0.69	136	0.24	22
See footnote	0.19[7]	31[7]	0.57[11]	40[11]	1.88[12]	279[12]	1.86[11]	130[11]			0.87[13]	8[13]	0.69	122
% of total	91	97	97	99	97	98	98	98	98	99	90	66	90	94

Table 1.47, continued

STATION	MID		M1E		NIA		NIC		N4A		N4B		04C	
	g	n	g	n	g	n	g	n	g	n	g	n	g	n
ALL ANIMALS	8.23	776	5.10	274	10.75	775	8.41	734	5.81	331	10.78	1180	3.04	424
Mysis littorals	4.91	524	1.39	64	1.12	159	2.92	156	0.37	71	7.28	760		
Mysis rel icta			1.92	84										
Saduria entomon	1,03	1	1.05	1					1.47	1				
Cal anus hyperboreus														
Thysanoessa raschii														
Amphipods and other crustacea	1.15	123	0.62	121	0.95	230	2,30	296	0.35	38	0.70	154	0.11	34
See footnote	0.451411514				8.55[11]	370[11]	3.04[11]	266[11]	3.33[7,11,13]	181[7,11,13]	1.91[11]	253[11]	2.82[7,11,13]	357[7,11,13]
% of total	92	98	98	99	99	98	98	98	95	88	92	99	96	92

Table 1.47, continued

STATION	04D g	04D n	04E g	04E n	P2D g	P2D n	P2F g	P2F n
	1.01	100	0.27	15	0.49	97	0.10	36
Mysis littorals	0.15	27			0.20	48		
Mysis relicta								
Saduria entomon								
Calanus hyperboreus							0.01	12
Thysanoessa raschii								
Amphipods and other crustacea	0.45	19	0.15	13	0.07	4		
See footnote	0.41[11,15]	45[11,15]	0.10[16]	1[16]	0.21[11,17]	43[11,17]	0.06[11,17]	21[11,17]
% of total	100	91	93	93	98	98	70	92

Footnotes

1. Calanoida
2. Delectopecten groenlandicus
3. Calanus sp.
4. Liparis sp.
5. 43 species total
6. Eualus gaimardii belcheri
7. Limacina helicina
8. Mollusca
9. Onisimus glacialis
10. Mysis sp.
11. Sagitta elegans
12. Diastylis sulcata
13. Portlandia arctica
14. Apherusa glacialis
15. Aglantha digitale
16. Myoxocephalus quadricornis
17. Oikopleura vanhoffeni

Repetitive Sampling of the Beaufort Nearshore Region in 1977

A. C. Broad

Introduction

In 1977, repetitive sampling at selected Beaufort and Chukchi shore stations was begun. This program was designed to yield data on composition of nearshore biota, whether this structure is stable or subject to seasonal variation, annual and seasonal reproductive events, immigration to or emigration from the nearshore region, and other events that might contribute to ecological assessment. In this report, we deal with eastern Beaufort Sea stations sampled three times during the 1977 summer.

Methods

Beach transects and extensions of transects were made at Nuvagapak Point in the Arctic Wildlife Range, at Barter Island, Prudhoe Bay and in the Colville River delta. The locations of stations sampled are given in appended tables 2.1 to 2.7. The methods employed in sampling are those that have been reported previously. Infaunal benthos was sampled with a pole-mounted Ekman grab ($0.0231 m^2$) and washed in the field in a 0. 516 mm screen-bottomed pail. Motile, epibenthic organisms were sampled with a Wildco (Cat. No. 171) scrape/skid dredge with 1.05 mm mesh bag. Salinity and temperature data with a YS1 Model 33 SCT meter, surface plankton samples and substrate samples for bottom analyses were taken and will be dealt with in a future report.

All samples were preserved in the field in 10% formalin and shipped to Bellingham where they were sorted, weighed, and subsequently preserved in alcohol.

Results

Infaunal benthos at depths of less than about 0.5 m yielded virtually no animals during the 1977 sampling of selected stations. The yields of

Ekman grabs, expressed in grams of wet weight biomass per m^2 and number of individuals per m^2 of several taxonomic categories of animals, percentage composition of the fauna in both mass and numbers, and average weights of individuals are given in Tables 2.1 to 2.7 appended to this section. Tables 2.8 to 2.14 give comparable data for motile, epibenthic animals taken in the scrape/skid dredge or sled net. Those wet weight biomass data expressed as "K" values are in grams rounded to the nearest 100 mg. When large catches of mysids were made, the total biomass so far exceeded that of other animals that errors introduced by this abreviation are negligible.

Discussion

In Nuvagapak Lagoon, Prudhoe Bay, and the Colville River delta (Tables 2.2, 2.5 and 2.7), infaunal biomass was greater than at other stations which probably reflects not only the larger number of samples and the greater depth of the collections but also a stability based on that depth and the larger biomass. The shallower stations sometimes showed marked variation between sampling periods attributable to motile isopods and amphipods included in the samples and to generally low numbers of individuals and, possibly, to patchy distribution. Nevertheless, the infaunal benthos was, throughout, more stable than was the epibenthos (Tables 2.7 to 2.14).

The samples made with the sled net must not be compared directly with those taken with the Ekman grab. While the latter are quantitative, the sled net, at best, is approximately so. The area covered by the net during a 50mtow is approximately 19 m^2, but the net does not behave in a standard manner when towed, sometimes digging in and sometimes skimming the surface. Animals may avoid the net which, when full or partially so, tends to push water away from its mouth. The sled net data, therefore, are used only in comparison within that group, but trends shown in the epibenthos may be considered along with trends in the infaunal benthos.

While the benthos was generally stable, the catches of the epibenthic sled net varied widely in numbers and in biomass during the summer. The samples from the deeper stations (Tables 2.9, 2.12, and 2.14) were generally larger than those from the shallower ones, especially when comparisons were made between locations close to one another, but, as noted elsewhere by us, the differences between nearshore and inshore epibenthic crustacean samples is not as striking as is the difference between the infaunal populations of the two regions.

A reasonably consistent trend in the samples of both motile, epibenthic animals and infauna is an increase in the number of individuals in midsummer over that in the earliest samples. In part, this may be the result of immigration into the nearshore region following melting of the shorefast ice, but this would hardly obtain for oligochaetes and polychaetes. Despite the increase in number, there is usually a decrease in polychaete biomass in midsummer, and this is reflected in a smaller average size of individuals. A decrease in average size of infaunal amphipods also is shown in the Ekman grab data, but generally (Table 2.8 provides an exception) epibenthic amphipods and mysids increased in number and biomass in midsummer and, hence, in average size of individuals.

These observations are consistent with early summer recruitment of young (following late winter or spring reproduction) polychaetes and infaunal (burrowing) amphipods which begin to enter catches by midsummer. If the same recruitment obtains for mysids, our data do not illustrate it.

In a most general way, our data for polychaetes, mysids, and Saduria entomon show a larger average size of individuals in late summer than in midsummer and, often, a decrease in both number and biomass. Such trends are consistent with growth and predation during the summer. Our infaunal amphipod data also show that larger individuals were caught late in the summer. The sled net, however, which should be less effective in sampling burrowing forms (but Pontoporeia affinis was abundant in these catches) caught usually smaller amphipods at the summer's end than it had earlier. Whether this apparent decrease in average size is the result of recruitment of young later in the season, we are not prepared to say.

It should be stressed that the data on which this brief discussion was based are quotients of biomass of samples divided by number of individuals. Such statistics may suggest dynamics of populations and, thereby, indicate the desirability of studies, but can not, in themselves, establish recruitment, predation or growth rates. The trends noted could also have resulted from different mobility of different sizes of the more active animals.

TABLE 2.1. NUVAGAPAK POINT - BENTHIC FAUNA IN 1977. DATA ARE FROM EKMAN GRAB SAMPLES TAKEN ON: A = 7/29,30, B = 8/15,16, AND C = 9/1, AND WASHED THROUGH A 0.516mm SCREEN. NUMBEROF SAMPLES IS: A = 11, B = 7, C = 4. SAMPLES WERE TAKEN AT:

STATION	N. LATITUDE	W. LONGITUDE	DEPTH (m)
B16	69°54.4′	142°16.8′	0.5
B17	69°53.3′	142°18.0′	0.5

TAXONOMIC CATEGORY	BIOMASS g/m²			BIOMASS %			NUMBER n/m²			NUMBER %			mg/INDIVIDUAL		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
POLYCHAETES															
OLIGOCHAETES															
ISOPODS[1]	17.24	0.02		95	2		42	7		43	3		410.48	2.86	
AMPHIPODS	0.94	0.83	7.54	5	89	100	56	137	368	57	62	100	16.79	6.06	20.49
OTHER		0.08			9			76			35			1.05	
Σ	18.18	0.93	7.54	100	10II	100	98	220	368	100	100	100			

[1] *Saduria entomon*

TABLE 2.2. NUVAGAPAK LAGOON - BENTHIC FAUNA IN 1977. DATA ARE FROM EKMAN GRAB SAMPLES TAKEN ON: A=7/28, B = 8/14, AND C = 9/1, AND WASHED THROUGH A 0.516mm SCREEN. NUMBER OF SAMPLES IS: A = 18, B = 18, C = 17. SAMPLES WERE TAKEN AT:

STATION	N. LATITUDE	W. LONGITUDE	DEPTH (m)
BIF	69°53.4′	142°18.0′	1.0
BIG	69°53.6′	142°17.5′	3.0
BIH	69″53.8′	142°15.8′	2.5

TAXONOMIC CATEGORY	BIOMASS						NUMBER						mg/INDIVIDUAL		
	g/m			%			n/m			%					
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
POLYCHAETES	11.95	11.88	7.78	30	40	26	1366	2640	1754	48	39	59	8.75	4.50	4.44
OLIGOCHAETES	0.56	0.45	0.18	1	2	1	714	724	402	25	11	14	0.78	0.62	0.45
ISOPODS	3.72	1.56		9	5	0	29	24		1	0	0	128.28	65.00	
AMPHIPODS	3.42	2.64	2.39	9	9	8	291	534	308	10	8	10	11.75	4.94	7.76
OTHER[1]	20.23	12.82	20.13	51	44	66	416	2902	499	15	43	17	48.63	4.42	40.34
Σ	39.89	29.34	30.49	100	100	101	2816	6824	2963	99	101	100			

[1] *Molgula griffithsii*

TABLE 2.3. BARTER ISLAND - BENTHIC FAUNA IN 1977. DATA ARE FROM EKMAN GRAB SAMPLES TAKEN ON: A = 7/24,25, B = 8/13, and C = none, AND WASHED THROUGH A 0.516mm SCREEN. NUMBER OF SAMPLES IS: A = 12, B = 3, C = 0. SAMPLES WERE TAKEN AT:

STATION	N. LATITUDE	W. LONGITUDE	DEPTH (m)
C38	70°06.2′	143°38.1′	0.4
C39	70°08.1′	143°39.2′	0.5

TAXONOMIC CATEGORY	BIOMASS g/m²			BIOMASS %			NUMBER n/m²			NUMBER %			mg/INDIVIDUAL		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
POLYCHAETES	0.04	0.03		1	6		7	43		0	4		5.71	0.70	
OLIGOCHAETES	0.49	0.35		18	69		649	909		42	91		0.76	0.39	
ISOPODS	0.02			1			14			1			1.43		
AMPHIPODS	1.08	0.01		39	2		101	14		7	1		10.69	0.71	
OTHER	1.12	0.12		41	24		757	29		50	3		1.48	4.14	
Σ	2.75	0.51		100	101		1528	995		100	99				

TABLE 2.4. PRUDHOE SHORE -BENTHIC FAUNA IN 1977. DATA ARE FROM EKMAN GRAB SAMPLES TAKEN ON: A = 7/19, B = 8/8, AND C = 8/21, AND WASHED THROUGH A 0.516mm SCREEN. NUMBER OF SAMPLES IS: A = 3, B = 3. C = 3. SAMPLES WERE TAKEN AT:

STATION	N. LATITUDE	W. LONGITUDE	DEPTH (m)
H28	70°18.5′	148°28.8′	0.5

TAXONOMIC CATEGORY	BIOMASS						NUMBER						mg/INDIVIDUAL		
	g/m²			%			n/m²			%					
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
POLYCHAETES															
OLIGOCHAETES	0.06	0.00	0.10	67		10	115	87	173	89	86	48	0.52	0.00	0.58
ISOPODS		0.01	0.36		99	37		14	72		14	20		0.71	5.00
AMPHIPODS			0.52			53			115			32			4.52
OTHER	0.03			33			14			11			2.14		
Σ	0.09	0.01	0.98	100	99	100	129	101	360	100	100	100			

TABLE 2.5. PRUDHOE BAY - BENTHIC FAUNA IN 1977. DATA ARE FROM EKMAN GRAB SAMPLES TAKEN ON: A = 7/29, B = 8/21, AND C = NONE, AND WASHED THROUGH A 0.516mm SCREEN. NUMBER OF SAMPLES IS: A = 12, B = 10, C = o. SAMPLES WERE TAKEN AT:

STATION	N. LATITUDE	W. LONGITUDE	DEPTH (m)
H2G	70°18.8′	148°27.3′	0.65
H2H	70°18.8′	148023.7	2.0

TAXONOMIC CATEGORY	BIOMASS						NUMBER						mg/INDIVIDUAL		
	g/m²			%			n/m²			%					
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
POLYCHAETE	0.62	3.95		12	53		462	1736		71	82		1.34	2.28	
OLIGOCHAETES	0.11	0.11		2	1		112	126		17	6		0.98	0.87	
ISOPODS	0.05			1			4			1			12.50		
AMPHIPODS	0.04	0.18		1	2		7	138		1	7		5.71	1.30	
OTHER	4.34	3.22		84	43		65	108		10	5		66.77	29.81	
Σ	5.16	7.46		100	99		649	2108		100	100				

TABLE 2.6. COLVILLE SHORE - BENTHIC FAUNA IN 1977. DATA ARE FROM EKMAN GRAB SAMPLES TAKEN ON: A=7/14, B = 8/5, and C = 8/23, AND WASHED THROUGH A 0.516 mm SCREEN. NUMBER OF SAMPLES IS: A = 6, B = 5, C = 5. SAMPLES WERE TAKEN AT:

STATION	N. LATITUDE	W. LONGITUDE	DEPTH (m)
J22	70°26.6′	150°22.1′	0.5

TAXONOMIC CATEGORY	BIOMASS						NUMBER						mg/INDIVIDUAL		
	g/m²			%			n/m²			%					
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
POLYCHAETES		0.58	0.19		38	10		113	18		52	7		5.13	10.56
OLIGOCHAETES															
ISOPODS	0.14	0.75	0.83	82	49	45	7	43	18	50	20	7	20.00	17.44	46.11
AMPHIPODS	0.03	0.20	0.81	18	13	44	7	61	216	50	28	86	4.29	3.28	3.75
OTHER															
Σ	0.17	1.53	1.83	100	100	99	14	217	252	100	100	100			

TABLE 2.7. COLVILLE DELTA - BENTHIC FAUNA IN 1977. DATA ARE FROM EKMAN GRAB SAMPLES TAKEN (IN: A = 7/15, B = 8/4,5, AND C = 8/25, AND WASHED THROUGH A 0.516mm SCREEN. NUMBER OF SAMPLES IS: A = 38, B = 28, C = 28. SAMPLES WERE TAKEN AT:

STATION	N. LATITUDE	W. LONGITUDE	DEPTH (m)
J2D	70°26.3′	150°22.0′	2.0
J2E	70′′26.3′	150°21.8′	3.0
J2F	70°26.3′	150°21.7′	2.5
J2G	70°28.8′	150°24.5′	2.0
J2H	70°29.0″	150°25.5′	3.0
J2I	70°29.2′	150°26.0″	2.0

TAXONOMIC CATEGORY	BIOMASS						NUMBER						nlg/Individual		
	g/m^2			%			n/m^2			%					
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	c
POLYCHAETES	3.44	3.19	6.6′0	43	54	67	1625	2150	2492	80	62	80	2.12	1.48	2,65
OLIGOCHAETES	0.35	1.26	0.48	4	2 2	5	322	1204	505	16	35	16	1.09	1.05	0.95
ISOPODS	3.81	1.22	2.36	48	21	24	44	47	23	2	1	1	86.59	25.96	102.61
AMPHIPODS	0.27	0.10	0.36	3	2	4	27	46	80	1	1	3	10.00	2.17	4.50
OTHER	0.04	0.09	0.01	1	2	0	13	17	2	1	0	0	3.08	5.29	5.00
Σ	7.91	5.86	9.81	99	101	100	2031	3464	3102	100	99	100			

Table 2.8. Nuvagapak Point epibenthic fauna in 1977. Data are from 50m tows of the sled net (see text. for description of net) taken on: A = 7/29, 30, B = 8/15,16; and C = 9/1. Number of samples is: A= 2, B = z, C = 2. Samples were taken at stations B16 and B17 (see Table 2.1).

TAXONOMIC CATEGORY	BIOMASS (mg)			NUMBER			mg/individual		
	A	B	C	A	B	C	A	B	C
MYSIS LITORAL IS	12K	1	59	1827	1	8	6.57		
MYSIS RELICTA	20K	7177	2358	1378	1524	215	14.51	4.71	10.97
CALANOIDA		6	17		31	4			
SADURIA ENTOMON	84	55		24	1				
AMPHIPODS[1]	610	733	3191	112	161	453	5.26	4.55	7.04
OTHER		41	2		1	4			
Σ	32.7K	8013	5627	3341	1719	684			

1. Mainly *Monoculodes packardi*, *Onisimus glacialis*, *Gammarus zaddachi*, *G. setosus*, *Monoculopsis longicornis*, *Halirages* sp., and *Gammaracanthus loricatus*.

Table 2.9. Nuvagapak Lagoon epibenthic fauna in 1977. Data are from 50m tows of the sled net (see text for description of net) taken on A = 7/29, 30; B = 8/15,16; and C = 9/1. Number of samples is A = 3, B - 3, C = 3. Samples were taken at stations BIF, BIG and BIH (see Table 2.2).

TAXONOMIC CATEGORY	BIOMASS (mg)			NUMBER			mg/individual		
	A	B	C	A	B	C	A	B	C
MYSIS LITORALIS	7270	22.6K	2141	1542	2710	188	4.71	8.34	11.39
MYSIS RELICTA	3425	34.9K	18.8K	723	3658	2413	4.74	9.56	7.78
CALANOIDA	2	140	85	15	279	84			
SADURIA ENTOMON	17	20	25	13	5	5			
AMPHIPODS[1]	681	5420	3344	240	1184	1005	2.84	5.39	2.82
OTHER	1686[2]	93.6K[3]	5839[4]	52	305	248			
Σ	13.1K	156.7K	30.2K	2585	8141	3943			

1. Mainly Monoculodes packardi, Onisimus glacialis, Gammarus zaddachi, G. Setosus, Monoculopsis longicornis, Halirages sp., anti Gammaracanthus loricatus.

2. Alcyonidium diciforme

3. Eucratia loricata

4. Molgula griffithsii

Table 2.10. Barter Island epibenthic fauna in 1977. Data are from 50m tows of the sled net (see text for description of net) taken on: A = 7/24, 25; B = 8/13; and C = 8/30. Number of samples is: A = 2, B = 2, C = 2. Samples were taken at stations C38 and C39 (see Table 2.3).

TAXONOMIC CATEGORY	BIOMASS (mg)			NUMBER			mg/individual		
	A	B	C	A	B	C	A	B	C
MYSIS LITORALIS	3541	2205	2387	1184	299	176	2.99	7.37	13.56
MYSIS RELICTA	1341	5969	1800	388	812	133	3.46	7.35	13.53
CALANOIDA		3133[3]	128[2]		780[3]	14			
SADURIA ENTOMON	237	78	305	88	16	40			
AMPHIPODS[1]	1157	738	1038	862	131	305	1.34	5.63	3.40
OTHER	158	3783[2,4,5,6]	272	54	1713[2,4,5]	182			
Σ	6434	15.9K	4930	2576	3751	850			

1. Mainly Monoculodes packardi, Onisimus glacialis and Gammarus setosus

2. Enchytraidae

3. Calanus hyperboreus

4. Limacina helcina

5. Aglanthe digitale

6. Clione limacina

Table 2.11. Prudhoe shore epibenthic fauna in 1977. Data are from 50m tows of the sled net (see text for description of net) taken on : A = 7/19; B = 8/8; and C = 8/21. Number of samples is: A = 1, B = 1, C = 1. Samples were taken at station H28 (see Table 2.4).

TAXONOMIC CATEGORY	BIOMASS (mg)			NUMBER			mg/individual		
	A	B	C	A	B	C	A	B	C
MYSIS LITORALIS	23	33		5	3		4.6	11.0	
MYSIS RELICTA	60	40	80	13	16	12	4.62	2.5	6.66
CALANOIDA									
SADURIA ENTOMON	1	90	154	1	29	29			
AMPHIPODS[1]	1	151	502	1	18	44	1.0	8.39	11.41
OTHER	6	31	6	8	1	11			
Σ	91	345	742	28	67	96			

1. Gammaracanthus loricatus and Pontoporeia affinis

Table 2,12. Prudhoe Bay epibenthic fauna in 1977. Data are from 50m tows of the sled net (see text for description of net) taken on: A = 7/19; and B = 8/21. Number of samples is: A = 2, and B = 2. Samples were taken at stations H2G and H2H (see Table 2.5).

TAXONOMIC CATEGORY	BIOMASS (mg)			NUMBER			mg/individual		
	A	B	C	A	B	C	A	B	C
MYSIS LITORALIS	7 6	1515		10	105		7.6	14.43	
MYSIS RELICTA	4813	8501		1006	701		4.78	12.13	
CALANOIDA	31	107		22	47				
SADURIA ENTOMON	15	2		1	1				
AMPHIPODS[1]	116	68		49	16		2.37	4.25	
OTHER	761[2]	164		27	36				
Σ	5812	10.4K		1115	906				

1. Mainly Pontoporeia affinis, Gammaracanthus loricatus and Monoculodes packardi

2. Eucratia loricata

Table 2.13. Colville Shore epibenthic fauna in 1977. Data are from 50m tows of the sled net (see text for description of net) taken on: A = 7/14; B = 8/5; and C = 8/23. Number of samples is: A = 1, B = 1, C = 1. Samples were taken at station J22 (see Table 2.6).

TAXONOMIC CATEGORY	BIOMASS (mg)			NUMBER			mg/individual		
	A	B	C	A	B	C	A	B	C
MYSIS LITORALIS									
MYSIS RELICTA	69	343	1063	2	55	40	34.5	6.24	26.58
CALANOIDA									
SADURIA ENTOMON	58	26	118	7	5	7			
AMPHIPODS[1]	112	49	51	26	9	12	4.31	5.44	4.25
OTHER		71			1				
Σ	239	489	1232	35	70	59			

1. Mainly Pontoporeia affinis, Gammaracanthus loricatus and Onisimus litoralis.

Table 2.14. Colville delta epibenthic fauna in 1977. Data are from 50m tows of the sled net (see text for description of net) taken on: A = 7/15; B = 8/4,5; and C = 2/25. Number of samples is: A = 6, B =6, C =6. Samples were taken at stations J2D, J2E, J2F, J2G, J2H, and J21 (see Table 2.7).

TAXONOMIC CATEGORY	BIOMASS (mg)			NUMBER			mg/individual		
	A	B	C	A	B	C	A	B	C
MYS IS LITORALIS		80			16				
MYSIS REL ICTA	467	4440	2961	62	820	191	7.53	5.41	15.50
CALANOIDA									
SADURIA ENTOMON	699	6229	1097	117	324	15	5.97	19.23	73.13
AMPHIPODS[1]	7 2	888	315	18	102	52	4.0	8.71	6.06
OTHER	13	37		12	28				
Σ	1251	11.7K	4373	209	1290	258			

1. Mainly Gammaracanthus loricatus, Onisimus litoralis and Ponotporeia affi nis

An Arctic Kelp Community in Stefansson
Sound, Alaska: A Survey of the Flora and Fauna

Ken Dunton and Susan Schonberg

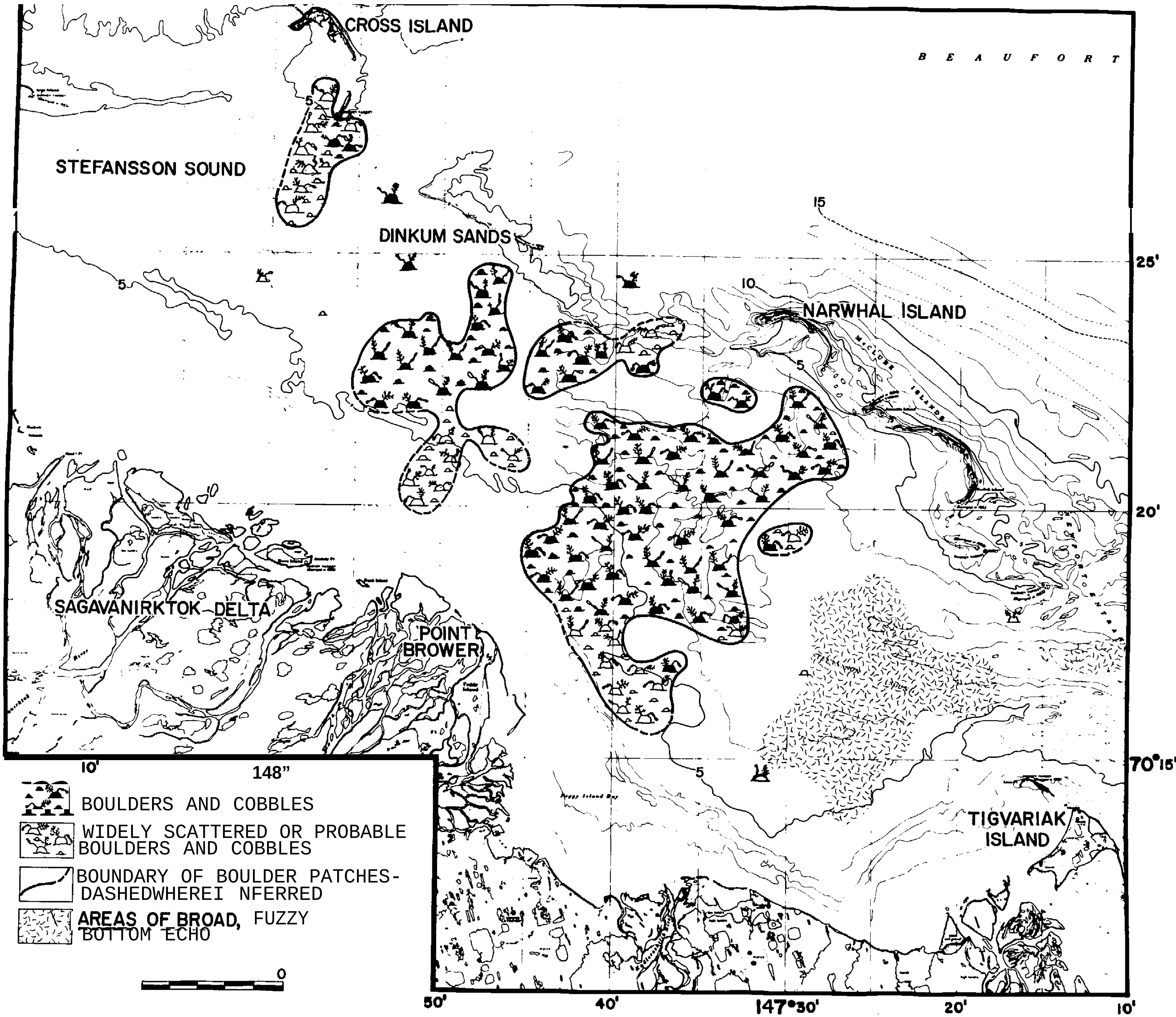
INTRODUCTION

In 1971, 1972, and 1976 the presence of a rich marine fauna associated with a "boulder patch" was reported in Stefansson Sound, Beaufort Sea, Alaska (Reimnitz and Toimil, 1976). This discovery subsequently led to a marine biological investigation of the area by divers in the summer of 1978 (Broad, 1978). During that expedition the existence of an Arctic kelp community was confirmed and a comprehensive survey of the flora and fauna conducted. The results of that survey, along with preliminary investigations of current growth and productivity experiments is the subject of this report.

The size and configuration of the boulder patch was charted by Erk Reimnitz (RU-205) of the United States Geological Survey in September, 1978 (Fig. 3.1). For the most part, this chart agrees with the diving observations made by us in Stefansson Sound during the same summer. A major part of our study, however, is now concentrated in one area of the boulder patch where the cover of rocks and kelp on the sea floor approaches 100% in places. This diving site, known as DS-11, is the focus of ecological studies being conducted by this group and has become a principal sampling site in the integrated OCSEAP winter effort.

Kelp beds, along with their associated invertebrate fauna, are rare features of the Alaskan Beaufort Sea. Recent sampling efforts in this region have revealed a faunal assemblage of polychaetes, tiny crustaceans, and molluscs (Dunton, 1979a; Broad et al., 1978; Feder and Schamel, 1976; Crane and Cooney, 1974) but little in the way of algae. This is probably due to the nature of the bottom, which is almost entirely soft and fine grained in nature. This fact cannot be over emphasized--Kjellman (1883) in his treatise on Arctic algae states, "it is certain and undeniable that the growth of marine algae, their distribution, richness, variety, and luxuriance, are essentially connected with and dependent upon the physical

Fig. 3.1. The location of the boulder patch. From Reimnitz and Ross (1978).


CROSS ISLAND
BEAUFORT
STEFANSSON SOUND
DINKUM SANDS
NARWHAL ISLAND
McCLURE ISLANDS
SAGAVANIRKTOK DELTA
POINT BROWER
TIGVARIAK ISLAND
Foggy Island Bay
5
10
15
25'
20'
70°15'
10'
148"
50'
40'
147°30'
20'
10'
BOULDERS AND COBBLES
WIDELY SCATTERED OR PROBABLE BOULDERS AND COBBLES
BOUNDARY OF BOULDER PATCHES- DASHEDWHEREI NFERRED
AREAS OF BROAD, FUZZY BOTTOM ECHO
0

nature of the bottom" and "wherever the bottom is very loose, i.e. formed of mud, sand, and clay, algae are wanting, because there are here no larger solid objects to afford that foothold which they need, at least during some part of their existence, in order to attain full and normal development." Nevertheless, kelp occur as drift and kelp beds have been occasionally documented in the Alaskan Arctic. Mohr, et al. (1953) dredged in a kelp bed just east of Barrow near Peard Bay in the Chukchi Sea and found abundant laminarioids along with red algae but "relatively few" invertebrates. Laminarioids were also collected off Tigvariak Island and Spy Island by the Canadian Arctic Expedition 1913-1918 (Collins, 1927). Fragments of kelp have been reported in Harrison Bay, Western Simpson Lagoon, offshore of Jones Island, west of Narwhal, west of Flaxman and in Camden Bay (Wilimousky, cited in Mohr, 1953) by various U.S. Arctic expeditions.

Perhaps the first diver to observe the kelp beds off Point Barrow was Stewart Grant (pers. comm.) who photographed them in 1970. His pictures show a bottom littered with laminarioids attached to shells, pebbles and small rocks but devoid of attached invertebrate life. Presumably, a combination of limited substrate and the unstable nature of the bottom prohibited the colonization and establishment of sessile marine invertebrates. The recent discovery of a large boulder patch associated with much kelp and a rich marine fauna and flora was therefore noteworthy, environmentally in terms of industrial development, and ecologically in terms of pure scientific interst.

As a result of this discovery and the subsequent SCUBA observations by Reimnitz and Toimil (1976), a comprehensive biological survey on the diversity and abundance of biota and extent of the boulder patch was completed in the summer of 1978. Since then the emphasis has been on learning more about the ecology of the community. Long term _in situ_ experiments initiated in August, 1978, were designed to provide information on; (1) sedimentation rates, (2) the growth rates of algae and (3) the rate and time of colonization, growth, and establishment of animals and algae on bare rock surfaces. Such information, along with baseline summer and winter data, will hopefully reveal the age and health of the community, its importance in the Arctic ecosystem in terms of energetic and organic productivity, and its resilience to physical disturbance.

The Stefansson Sound kelp community consists almost entirely of organisms that are sessile, and they must either cope with or succumb to unfavorable environmental conditions created by offshore industrial activities. Two problems which benthic organisms in this community are most likely to face as a result of these activities are, (1) chemical contamination of their environment, and (2) physical disturbance. This study is not concerned with the effects of contaminants on marine organisms.

The potential physical effects of offshore oil and gas exploration may well deserve the greatest consideration with regard to the Stefansson Sound kelp community. The proximity of the boulder patch to already existing drill sites (e.g. Exxon Duck Island, six miles) and its presence within a lease area might further endanger a community which is already considered rare. These physical effects could be either direct or indirect. A direct effect would involve an actual spatial conflict between industrial equipment and the benthic community itself. Increased rates of sedimentation (smothering the organisms) and higher water turbidity (decreasing the amount of light available for the algae) as a result of bottom disturbances upstream from the community are examples of possible indirect physical effects. A knowledge of the organisms and the process ofcommunity development through creation of artificial disturbances should provide some insight with respect to management of the region.

STUDY AREA

The diving effort was carried out in the region of Stefansson Sound located between Foggy Island Bay to the south and the McClure Islands on the north (Fig. 3.1). The Sagavanirktok River discharges into Stefansson Sound about six miles southwest of the principal diving sites. Water depths ranged between 6 and 9 meters at all dive locations and the composition of the sea floor varied considerably.

Cobbles and boulders covered with marine growth were found in only 7 of 16 locations examined (Table 3.1). Of these seven, six were located within a two square mile area (Fig. 3.2). Most of the sea bottom in this region consisted of scattered pebbles, cobbles, and boulders on a base of soft mud or hard, compacted clay. Boulders up to two meters across and a meter high were sometimes observed. At DS-11 the sea floor was littered

TABLE 3.1. Location of dive sites in Stefansson Sound during the 1978 Summer field season.

Dive Site	Latitude	Longitude	Kelp Transect	Occurrence of Kelp	Comments
DS- 1	70°20.5′	147°34.8′	X	X	
DS-2	70°20.8′	147°44.5′			
DS-3	70°20.4′	147°38′	X	X	
DS-4	70°21′	147°38.6′			
DS-5	70°21.4′	147°39.3′			
DS-6	70°21.8′	147°39.8′			
DS-7	70°22.4′	147°40.8′			
DS-8	70°23.1′	147°41.8′		X	
DS-9	70°20.4′	147°35.6′		X	
DS-10	70°20.2′	147°35.3′		X	
DS-11	70°19.5′	147°34.5′	X	X	Winter site pinger deployed
DS-12	70°20.8′	147°36.2′		X	Pinger deployed
DS-13	70°21′	147°34.3′			
DS-14	70°21.2′	147°42.7′			
DS-15	70°20.8′	147°40.3′			
DS-16	70°20.6′	147°39′			

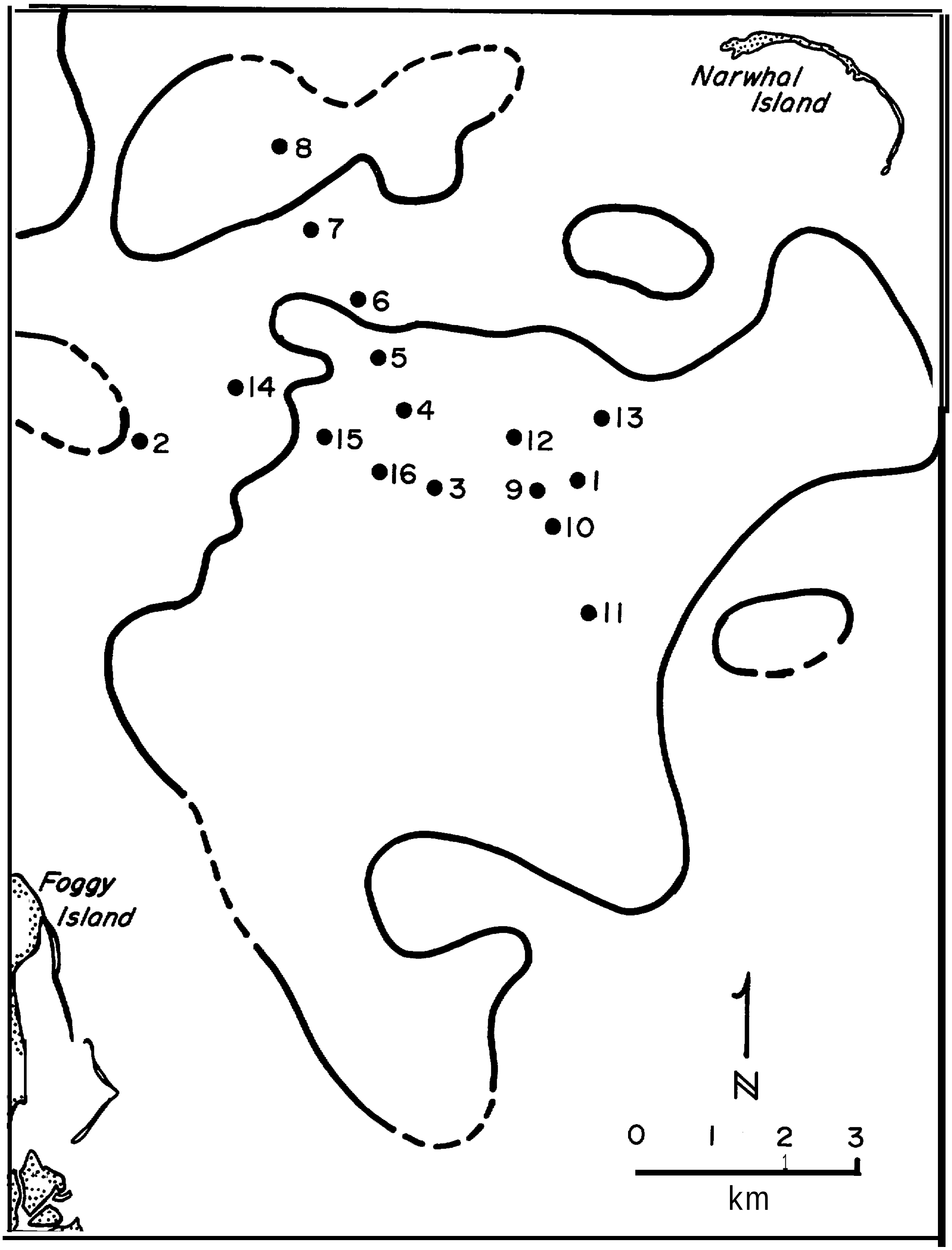


Fig. 3.2. The location of the dive sites in Stefansson Sound in relation to the boulder patch as mapped by Reimnitz and Ross (1978).

with rocks and supported an extensive kelp community of unknown size. This site became the focus of the winter sampling program. A layer of silt, which varied in thickness during the year, was usually observed on algae and rock surfaces.

Reimnitz and Ross (1978) believe the gravel, cobbles, and boulders in Stefansson Sound are lag deposits resulting from the erosion of boulder-rich portions of the Gubic formation. These rocks are thought to be part of the Flaxman formation (Leffingwell, E. de K., 1919) which were believed to have been ice rafted into the area and became part of the Gubic Formation at an earlier time. The existence of this boulder bed, in what appears from its close proximity to the Sagavanirktok River to be a depositional environment, raises important questions yet to be answered.

METHODS

Summer Field Sampling and Logistics

The field team for this project consisted of a team leader/diver, two SCUBA divers, and a marine technician. During the summerwe operated from Narwhal Island, about five miles from the principal dive sites in Stefansson Sound. Facilities were provided by the Naval Arctic Research Laboratory which maintains a camp on the island. Other field support including NOAA helicopter assistance, housing facilities in Deadhorse, and a 21 foot Boston Whaler were provided by OCSEAP. The Boston Whaler was used in transportation to and from the dive sites for ten day periods between July 20 and August 21, 1978. For a more detailed account of the field activities of this group during the 1978 summer field season see Dunton (1979b).

Exploration of the Stefansson Sound boulder patch was accomplished by a diving survey during the summer of 1978 which involved spot diving along transects of known degree bearings. Occasionally a Ross SL 500 recording fathometer was used in such exploratory work, but its effectiveness as a tool to delineate the presence or absence of boulders varied. Typically, following the successful location of a kelp bed, the site was marked with buoys and a 50 meter transect line (marked in meters) set on the bottom. Once in the water, divers used an underwater communications system to coordinate work efforts and relayed data to a surface tape recorder. Based on visual observations while swimming the transect line, divers reported information (and responded to inquiries from the surface) on:

1. The physical environment, which included data on approximate water turbidity and visibility, and currents.
2. The sea floor, which included comments on the nature of the sediments, topographical features, surface detritus, and quantitative data on rock and algal cover.
3. The biota, which involved a description of the organisms seen, collected, or photographed, and any notes on their respective density, location or behavior.

In addition to the visual observations and collections made by divers, an attempt was made to obtain quantitative data on the biota without using destructive sampling techniques. This was accomplished by mounting a camera on an apparatus which framed pictures into either a 1/4 or 1/20 m^2 format (Fig. 3.3). These photographs were taken on various rock substrata at random and were used to obtain density estimates of many invertebrate species (Fig. 3.4). A Nikonas III camera equipped with a 15 mm Nikkor wide angle lens and Nautilus YS-35 and YS-150 strobes was used in all the underwater photography. To aid in laboratory identification, close-up pictures of the organisms were taken with extension tubes on a 28 mm Nikkor lens to obtain a 1:2 reproduction ratio.

Winter Field Sampling and Logistics

Data from in situ experiments initiated in August, 1978, were collected at Dive Site 11 in November, 1978 and March 1979. A Helle pinger receiver was used to locate a pinger marking the dive site under the ice. Divers worked from a dive hole located inside a heated 16 x 20 foot NARL parcoll. OCSEAP provided field logistic support, lodging in Deadhorse and NOAA helicopter assistance.

Because floculent sediment was easily stirred up by turbulence, sampling was done by one person at a time in November. A second person remained on standby and rotated with the first between active and standby duty. The divers were tethered to the surface and equipped with a complete back-up air support system. Each of the two divers made two dives per day, working in total darkness under extremely turbid conditions.

Fig. 3.3. Feet high to avoid stirring bottom sediments, a diver photographs the boulder patch benthic community using a 1/4 m^2 framer. The headphones are used in underwater communications.

Fig. 3.4. A close-up of the benthic community using a 1/20 m^2 camera framer reveals an assortment of sponges, red algae, and hydroids. The sponge near the top of the framer is *Choanites lutkenii*; below it are two sponges of *Phakettia cribrosa*. Hydroids are scattered, but one clump can be seen on the top left. The red algae include *Lithothamnium* (encrusting), *Rhodomela subfusca* (filamentous, to the right of the sponges), and *Phycodrys rubens* (clump to the left of the sponges).


August 20, 1978
DS-11

The following tasks were completed ·n both November and March.

1. Analyze and/or photograph experimental plots used in recolonization studies. Denude new plots where designated by team leader.
2. Measure tagged kelp to obtain new growth increments. Tag and punch additional individuals.
3. Measure sediment depth in trays and install new trays.
4. Record physical measurements on visibility, ice thickness, currents, water temperature, salinity; note changes in the physical environment.
5. Photograph the community.
6. Collect new or uncommon organisms.
7. Note changes in the biotic components.
8. Sample the benthic infauna using an airlift (March).
9. Determine algal biomass per m^2 (March).
10. Assist Schneider (RU-356), Schell (RU-537) and Homer (RU-359) in underwater sampling.
11. Study underice features with Reimnitz (RU-205) in March. This team" also retrieved equipment for Matthews (RU-526), and assisted in underwater studies for LGL (RU-467) and Carey (RU-6) under additional OCS contract funding.

RESULTS AND DISCUSSION

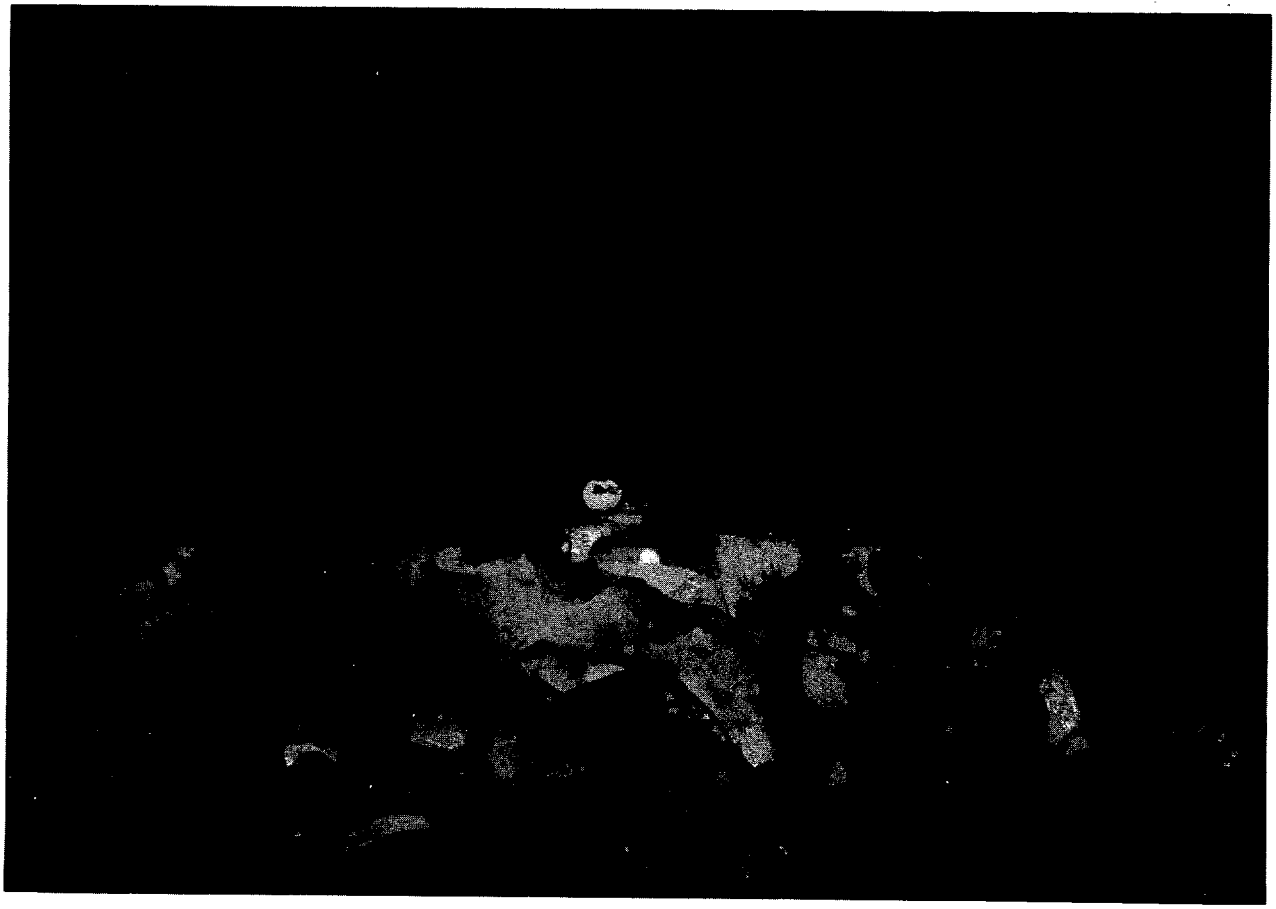
The Nature of the Boulder Patch and the Physical Env ronment

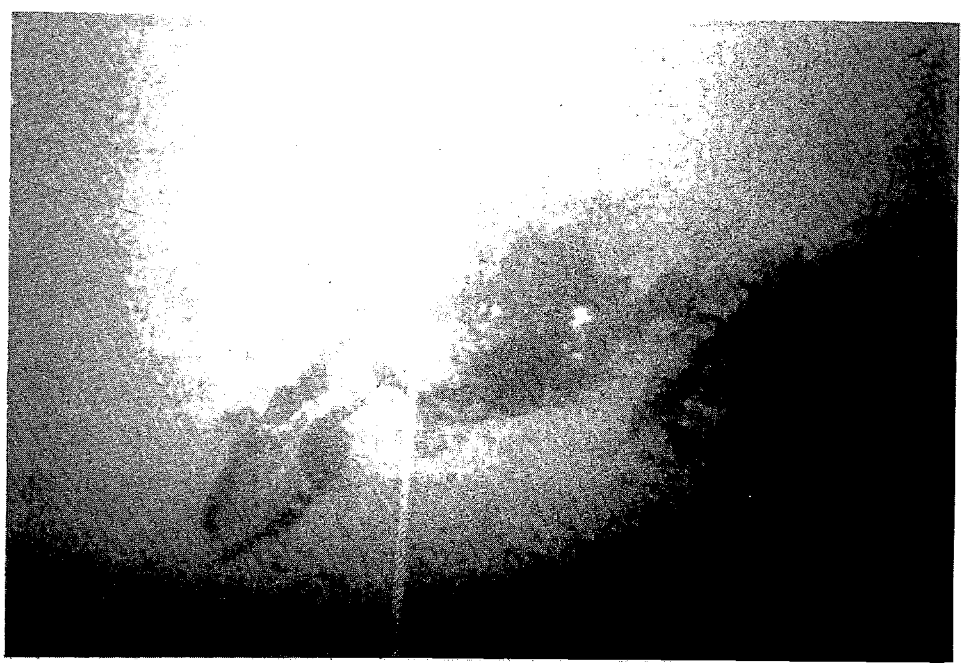
The Stefansson Sound boulder patch ·ncludes two types of habitats; (1) dense rocky areas, rich in flora and fauna and extensive in nature (Fig. 3.5), and (2) regions of scattered rocks characterized by isolated patches of marine life (Fig. 3.6). Several kelp beds were found by this team in Stefansson Sound, three of which (DS-1, US-3, and DS-11) were studied and sampled. Kelp and attached animal life were also observed at DS-8, DS-9, DS-10, and DS-12. All sites in which kelp were reported lie within the confines of the boulder patch as mapped by Reimnitz (Fig. 3.2). Dive Site 11 was the only area that had a densely covered rock bottom with an extensive and abundant flora and fauna.

Regions characterized by cobbles or boulders were usually associated with a hard bottom consisting of either stiff silty clays, or well consolidated coarse materials (e.g., gravels and sands). At DS-8 the bottom consisted entirely of coarse sands which were probably transported from

Fig. 3.5. A view of the kelp community at DS-11. A light patch or sorus (the fertile portion of the plant) appears on many of the *Laminaria* blades. The sponge in the center is *Choanites lutkenii*.

Fig. 3.6. Our transect line intersects a patch of rocks with attached plant and animal life at DS-1. The area around the rocks is mud and silt.





nearby barrier islands. At other areas examined, the bottom consisted of soft muds and silts. Silt was present at all sites examined and was particularly evident on lighter rock surfaces. It was easily thrown into suspension by the divers and was the primary cause of poor underwater visibility. A summary of the physical characteristics of each dive site including data on the nature and content of the sea floor is presented in Table 3.2. Dive Site 11 had the densest rock (41.7%) and algal cover (37.3%), was the shallowest of the dive sites and was the most extensive in terms of rock cover. A diving survey showed boulders and cobbles covering at least 40,000 square meters of sea floor in the area.

Salinity and temperature data were recorded through the summer at various diving sites (Table 3.3). Water temperatures rose 4.7 degrees to a high of 7.9°C in early August, as salinities dropped 4.5 ppt to a low of 22.4 ppt. By late August temperatures had dropped to less than 1°C and salinities had risen to 26.3 ppt. Salinities were generally higher and temperatures lower at the bottom than at the surface, the difference being on the order of 0.2 -2.5 ppt and 0.5 - 2 degrees respectively.

The Flora and Fauna of the Stefansson Sound Boulder Patch

The Stefansson Sound boulder patch supports a well established kelp community characterized by several species of red and brown algae, and a diverse assortment of invertebrate life reporesenting every major taxonomic group. The most conspicuous and dominant member of the community is the brown alga, *Laminaria solidungla* which is exclusively circumpolar in distribution. Two other kelp species, *Laminaria saccharin* and *Alaria esculenta* appear occasionally and together with *L. solidungla* from a brown algal overstory. In areas where kelp cover was reduced or absent, another floral assemblage, typified by several species of filamentous and bladed red algae, dominated (Figs. 3.4, 3.7 and 3.8). These species ineluded *Phycodrys rubens, Neodilsea integra, Phyllophora* truncata, *Rhodomela subfusca* and to a lesser extent, *Odonthalia dentata* and *Ahnfeltia plicata*. These red algal species, along with *Lithothamnium*, a widespread encrusting red algae, comprised a patchy algal understory.

TABLE 3.2. Summary of the dive sites in Stefansson Sound. Rock and algal covers at DS-1, DS-3, and DS-11 are mean scores calculated from at least 23 one m^2 quadrats. In all other cases, with the exception of water depth and current direction, the data represent independent estimates made by the divers.

Dive Site	Date	Depth (m)	Visibility (m)	Current (knots) and Direction	Rock Cover %	Algal Cover %	Description of Sea Floor
1	7/23, 24,25	6.4-7.3	3.5	0	6.5	6.8	Mud and hard clay with cobbles and boulders in scattered patches; much silt, some pebbles. Abundant marine life in rock patches.
2	7/22	6.7	2.5	0	<1	<1	Soft mud; scattered buried pebbles with attached kelp (probably drift). Isopods and Ampharete worm tubes common. Peat ledges (?) observed.
3	8/3, 4,5	6.4-7.6	3.0	ENE @ ¼ on 8/4	19.4	21.6	Clay (?) overlayed by thin layerof mud and scattered patches of cobbles and boulders. Bottom not penetrable more than a few cm. Abundant marine life in rock patches.
4	8/7	8.1	3.5	W @ <¼	<1	<1	Mud and silt; scattered pebbles with attached kelp (probably drift) on surface and buried. Attached invertebrate life rare.
5	8/7	8.5	2.5	W @ <¼	<1	<1	
6	8/7	8.5	0.5	0	<1	<1	
7	8/7	8.5	1.0	W @ <¼	<1	<1	Mud; peat and terrestrial debris.
8	8/7	8.5	3.0	W @ <¼	5	5-10	Sand; ripple marks 1 foot apart and 3 inches high, no silt, clean bottom. Pebbles and small cobbles with attached kelp.
9	8/7	7.6	2.5	E @ <¼	1	<1	Hard impenetrable clay overlayed by thin (1 cm) layer of soft mud. Pebbles and cobbles scattered with attached kelp, boulders rare.

TABLE 3.2 continued

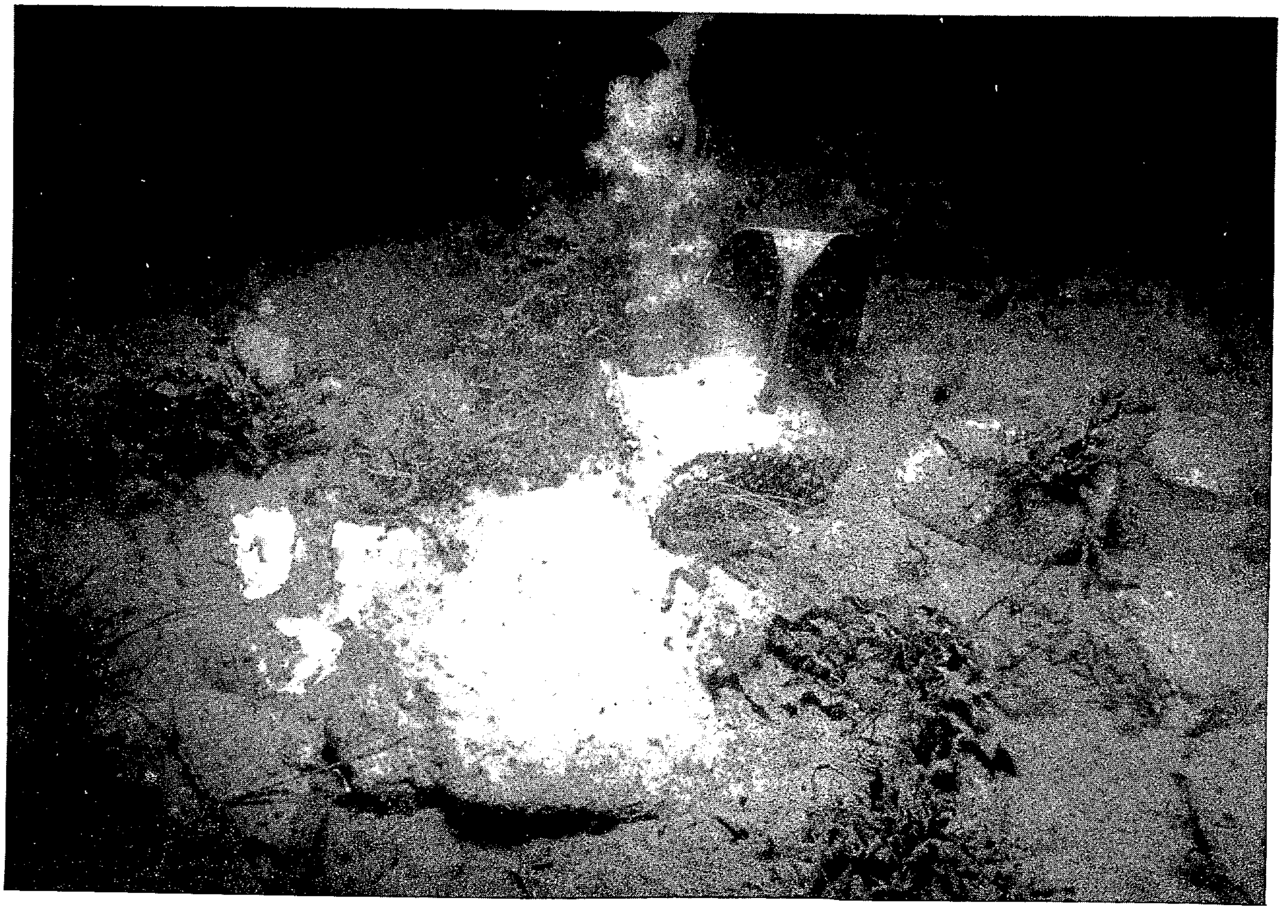
Dive Site	Date	Depth (m)	Visibility (m)	Current (knots) and Description	Rock Cover %	Algal Cover %	Description of Sea Floor
10	8/7	7.6	3.5	0	5	5-1o	Thin mud and silt layer (1 cm) overlays penetrable gravel-mud matrix. Cobbles frequent with kelp. Boulders rare.
11	8/7, 17,18, 19,20	5.4-6.4	3.0	W @ 1-2 on 8/17-8/20	41.7	37.3	Rocky, cobbles and boulders common, underlayed by penetrable gravel-mud matrix or unpenetrable clay. Kelp and invertebrate life abundant.
12	8/20	6.4	3.0	0	2-3	2-3	Mud, scattered cobbles and boulders with attached kelp and marine life.
13	7/23	6.4	2.5	0	<1	<1	Mud, bottom soft. Scattered buried pebbles with attached kelp (probably drift). _Ampharete_ worm tubes common.
14	8/3	6.7	1	0	0	0	Mud; very soft bottom.
15	8/3	6.7	1.5	0	0	0	Mud and silt; bottom hard but penetrable. _Ampharete_ worm tubes common.
16	8/3	6.7	2.0	0	<1	<1	Mud and silt; bottom soft. Scattered pebbles with kelp attached (probably drift) on surface and buried.

TABLE 3..3. Average salinity and temperature values at some of the diving sites in July and August. There was little variation in salinity and temperature between the surface and the bottom at any of the sites.

Date	Salinity	Temperature	Dive Site
July 22	26.9	3.2	DS-2
23	25.1	5.0	DS-1
24	26.0	6.5	DS-1
25	24.9	7.0	DS-1
August 3	25.8	6.7	DS-3
4	24.3	7.0	DS-3
5	22.4	7.9	DS-3
18	24.7	0.4	DS-11
19	26.3	0.8	DS-11

Fig. 3.7. Rocks and algae smothered with silt characterize the bottom at DS-11 in November, 1978. The pink soft coral Eunephytes rubiformis (top center) stands next to Laminaria solidungla. To the right of the seastar is the eelpout, Gymnelis viridis. An encrusting sponge is attached to Phycodrys (left middle).

Fig. 3.8. A close-up of the bottom at DS-11 shows a community dominated by the red encrusting alga Lithothamnium, and the bladed alga Phycodrys rubens. Other algae include Rhodomela subfusca (top) and Phyllophora truncata (bottom).



To a large degree, the diverse and rich assemblage of invertebrate and vertebrate animals is dependent on the microhabitats and additional substrate space afforded to them by the algae community.

A complete list of the fauna collected at the three principal dive sites (DS-1, DS-3, and DS-11) is presented in Table 3.4A. This table includes previously unencountered species collected by divers at DS-11 in November, 1978, and those reported living in the soft underice environment in March, 1979. In the context of this study a species was considered: widespread (W), if it was continually observed by a diver as he swam; common (C) if it was frequent in occurrence but not widespread; and rare (R) if it was encountered only occasionally. The species of algae taken by divers at the three sites are listed in Table 3.4B. The densities of large epilithic species and some of the motile invertebrates are depicted in Table 3.5A. Percent cover of the primary understory species--red algae, hydrozoans, and encrusting sponges are listed in Table 3.5B. The densities and percent covers were calculated from a total of 54 photographs of 1/20 m^2 quadrats taken at DS-1, DS-3, and DS-11. The densities and percent covers are based on areas of 40% rock cover or better.

Of the invertebrate phyla, the sponges and the cnidarians were the most conspicuous. This was due to the large size of some species, a high abundance, and their striking shapes and colors. Phakettia cribrosa and Choanites lutkenii (Fig. 3.4, 3.5) were abundant and had a combined density of $5.5/m^2$. The delicate pink soft coral Eunephtyes rubiformis (Fig. 3.7} was the most photographed organism of the boulder patch. It was widespread ($4.8/m^2$) and individuals from 2 cm in size to two feet in height were observed. At least four different colorful sea anenomes (order Actinaria) were photographed and collected, but remain unidentified. Cerianthus, an anenome-like anthozoan, was observed frequently but not collected. Tubularia, a stalked hydrozoan, was abundant at DS-1 and DS-3 but infrequent at DS-11. Its mean density of $2.6/m^2$ is considered high for all three dive sites. Other hydrozoans formed a turf like covering on rocks in company with small sponges, bryozoans, Rhodomela (a filamentous red alga), and stringy masses of the red alga Phycodrys (Fig. 3.4).

TABLE 3.4A. An annotated list of the fauna collected at three dive sites in the Stefansson sound boulder patch in July and August, 1978. "N" or "M" denote organisms collected in November, 1978 or March 1979 respectively. Frequency estimates are denoted as: W = widespread, C = common, or R = rare (see text) and are presented where possible.

ORGANISM	DS 1	DS 3	DS 11	Fre-quency	Comments
INVERTEBRATE					
PORIFERA					
Haliclona gracilis	X	X	X	C	
Halichondria panicea	X	X	X	W	Found on rocks, common on stems of hydroids & bryzoans
Phakettia cribrosa	X	X	X	W	See Fig. 4
Choanites lutkenii	X	X	X	W	See Fig. 4, 5
Suberites montiniger	X				
Suberites sp.	X	x	x		
CNIDARIA					
THECATE HYDROZOA					
Abietinaria abietina	X	X		C	
Sertularia cupressoides		X	X	W	
Thuiaria sp.		X	X	W	
ATHECATE HYDROZOA					
Corymorpha sp.		X		R	
Tubularia indivisa	x		X	C	
Tubularia regalis	X			R	
Hydractinia carica				C	Found on Neptunea heros
Hydractinia sp.	X				Found on Neptunea borealis
ANTHOZOA					
ACTINARIA	x	X	X	C	
ALCYONARIA					
Eunephtyes rubiformis	X	X	X	W	See Fig. 7
SCYPHOZOA					
Lucernaria infundibulum		X		R	
NEMERTEA			X		

Table 3.4A, continued

ORGANISM	DS 1	DS 3	DS 11	Frequency	Comments
NEMATODA	X	X	X		
ANNELIDA					
POLYCHAETA					
Cirratulus cirratus	X		X		
Brada sachalina	X				
Anaitides groenlandica		X	X	C	Two specimens collected in August were gravid.
Harmothoe imbricata		X			
Gattyana cirrosa	X				
Melaenis loveni		X			
Antinoella sarsi			X(M)		Gravid, collected in soft ice
Exogone verugera	X				
Nereis zonata	X				
Spinther alaskensis		X	X	C	
Potamilla neglects	X		X	C	Lives in membranous tube
Spirorbis granulatus	X	X	X	W	Lives in calcareous tube
Spirorbis sp.	X	X	X	W	
MOLLUSCA					
POLYPLACOPHORA					
Amicula vestita	X	X	X	W	
Ischnochiton albus			X	R	
GASTROPODA					
PROSOBRANCHIA					
Onchioiopsis borealis	X			R	
Margaritas vorticifera	X	X	X	C	
Natica clausa	X	X		C	
Buccinum angulosum			X	C	
Beringius beringii			X	R	
Plicifusus kroyeri	X	X	X	c	
Colus spitzbergensis		X	X(N)	R	
Neptunea heros			X	c	

Table 3.4A, continued

ORGANISM	DS 1	DS 3	DS 11	Fre-quency	Comments
Neptunea borealis	X			C	
Oenopota harpa		X		R	
GASTROPOD EGGS					
Neptunea sp.	X				
Buccinum sp.	X		X	C	Found on stems of Laminaria solidungla
Polinices sp.	X				An egg collar
Unknown		X			
NUDIBRANCHIA	X	X	X	C	
PELECYPODA					
Musculus discors		X		F?	
Musculus niger	X			R	
Astarte borealis		X		R	Many empty valves of this species were collected
Astarte montagui	X			R	
Mya pseudoarenaria			X(N)	R	
PYCNOGONIDA.					
Nymphon grossipes	X		X	C	
ARTHROPODA					
CRUSTACEA					
ISOPODA					
Saduria entomon		X	X	R	Not common at DS-11
AMPHIPODA					
Halirages sp.			X		
Acanthostephia behregensis	X		X	C	
Atylus carinatus	X		X		
Onisimus glacialis	X		X	C	
Gammaracanthus loricatus		X	X	C	Specimens collected under soft ice in Nov. & March (gravid)
Weyprechtia hueglini			X(M)		Collected under soft ice--some gravid
Gammarus setosus			X(M)		
Melita formosa			X(M)		

Table 3.4A, continued

ORGANISM	DS 1	DS 3	DS 11	Frequency	Comments
DECAPODA					
Pagurus trigonocheirus	X	X	X	C	In Neptunea shells
Hyas coarctatus alutaceus	X	X	X(N)	C	
BRYOZOA					
Alcyonidium disciforme	X			R	
Alcyonidium gelatinosum			X	R	
Flustrella gigantea		X	X	C	
Flustrella sp.	X			C	
Flustra carbasea	X	X		R	
Eucratea loricata	X		X		
Bugulopsis peachi			X		Attached to live Neptunea
Callopora lineata		X			On Phycodrys and Phakettia stems
Hippothoa hyalina	X	X	X		On Phyllophora and hydroid stems.
Umbonula arctica	X	X	X		Found on hydroid stems
Cauloramphus intermedius	X	X	X		Found on hydroid stems
Cellepora nordenskjoldi	X				In form of round ball
ECHINODERMATA					
ASTEROIDEA					
Crossaster papposus			X(N)	R	10 rays
Pedicellasteridae	X			R	
Leptasterias groenlandica	X	X	X	C	5 rays
Leptasterias polaris	X	X			6 rays
CHORDATA					
ASCIDIACEA					
Moguls griffithsii		X		R	Translucent--attached to Rhodomela
Dendrodoa aggregata			X	R	
Chelyosoma macleayanum		X		R	

Table 3.4A, continued

ORGANISM	DS 1	DS 3	OS 11	Fre-quency	Comments
VERTEBRATE					
<u>OSTEICHTHYES</u>					
Boreogadus saida			X(N)	C	
Gymnelis viridis			X(N)	C	See Fig. 7
Myoxocephalus quadricornis			X(N)	R	
Liparis cyclostigma			X(N)	R	Juveniles
Liparis herschelinus (?)			X	W	Adults and juveniles
<u>OSTEICHTHYES EGGS</u>					
Species A			X	C	Eggs are 4mm D and bright yellow
Species B		X	X	C	Eggs are 2.5 mm D and brownish-tan
Species C			X(M)	W	Eggs are 1-2 mm D and whitish-tan

TABLE 3.4B. Algae collected at the three dive sites in the Stefansson Sound boulder patch during July and August, 1978.

ORGANISM	DS 1	DS 3	DS 11	Frequency	Comments
PHAEOPHYTA					
LAMINARIALES					
Laminaria solidungla	X	x	x	W	
Laminaria saccharin	x	x	x	C	
Alaria esculenta	X		X	R	
RHODOPHYTA					
CRYPTONEMIALES					
Neodilsea intergra	x	x	x	C	
Lithothamnium sp.	x	x	x	W	
GIGARTINALES					
Ahnfeltia plicata			X	R	
Phyllophora truncata	X	X	X	C	
CERIAMELES					
Phycodrys rubens	X	X	X	c	Epiphytic on Phyllophora, Neodilsea and Odonthalia
Rhodomela subfusca	X	X	X	c	
Odonthalia dentata	X	X	X	c	

TABLE 3.5A. Mean densities (n/m^2) of large epilithic and some non-epilithic invertebrates in the boulder patch based on 54 photographed 1/20 m^2 quadrats. Densities are based on a minimum of 40% rock cover. Hydrozoans and small sponge species are treated in Table 3.5B.

Species or Group	n/m^2
Spirorbis sp.	10.4
Eunephtyes rubiformis	4.8
Phakettia cribrosa	2.9
Choanites lutkenii	2.6
Tubularia sp.	2.6
Cerianthes sp.	1.2
Asteridae	0.9
Actinaria	0.6
Nudibranchia	0.3
Nymphon grossipes	0.3
Anaitides groenlandica	0.3
Pagurus sp.	0.3
Potamilla neglects	0.3
Alcyonidium gelatinosum	0.3
Flustrella sp.	0.2
Ascidiacea	0.2

TABLE 3.5B. Percent cover (%) of various red algal species, hydrozoans, and small sponges attached to rocks in the kelp community understory. Covers are based on 54 photographed 1/20 m^2 quadrats and a minimum of 40% rock cover.

Species or Group	Percent Cover (%)
Lithothamnium sp.	11.5
Phycodrys rubens	8.9
Phyllophera truncata	5.5
Hydrozoa (excepting *Tubularia*)	5.4
Neodilsea integra	2.4
Rhodomela subfusca	2.1
Porifera (excepting *Phakettia* and *Choanites*)	1.5
Odonthalia dentata	0.3

Polychaetes, nematodes, and nemerteans were usually collected in the soft sediment between the boulders and cobbles. Some of these worms made tracks in the top soft layer of sediment which were distinguishable from the wider tracks made by gastropod. The tubicolous polychaete Spirorbis granulates formed small (to 4 mm) spiralled tubes found on rocks, algae, hydroids and snail shells. Its calculated density of $10.4/m^2$ is probably low. The fanworm Potamilla neglects was less abundant but larger, its membranous tube having a length of 8 cm or better. In March, 1979 gravid polychaete scaleworms (Antinoella sarsi) were found living in the soft underice environment. Divers estimated their numbers at $0\text{-}3/m^2$.

Molluscs, particularly the gastropod Buccinum, Neptunea, Natica, Margaritas, and Plicifusus were collected frequently. Natica clausa was usually found on the blades of Laminaria as were about five different types of Nudibranchs. Egg clusters belonging to Buccinum were common on the stipes of Laminaria solidungla at several dive sites including DS-8. Pelecypods were not collected in abundance although many shells of Astarte borealis were scattered on the sea floor at the principal dive sites.

The largest mobile invertebrate was the crustacean Hyas coarctatus alutaceus. Divers frequently came across this animal and the hermit crab, Pagurus trigonocheirus, while working in thick kelp, but seldom saw them on kelp free bottoms. Other mobile crustaceans included numerous mysids (not collected), amphipods and rarely, isopods. In March, 1979 a number of amphipods were collected moving in and around the soft underice environment. Four species are listed in Table 3.4A.

Several five and six rayed seastars, Leptasterias spp. and one ten rayed sunstar, Crossaster papposus, were collected in this study. These seastars were found attached to rocks, Laminaria fronds, or lying on the sea floor. Only two feeding observations were recorded on these animals underwater. One seastar was seen eating a polychaete worm in August and three were feeding on the remains of a fish (Liparis) in March, 1979.

Sea spiders, bryozoans, and ascidians were some of the more unusual animals that fascinated the divers underwater. The sea spider (Pycnogonid) Nymphon grossipes, a bizarre looking animal underwater (a photograph appears in Dunton, 1979b) was occasionally seen scavenging around rocks beneath the kelp canopy. Bryozoans were found attached to rocks, on hydroids, and to the red algal species Phycodrys, Odonthalia, and Phyllophora. One translucent ascidian, Moguls griffithsii, was attached to the red alga Rhodomela.

Five species of fish were collected at DS-11. These included two species of the sucker fish Liparis, the arctic cod (Boreogadus saida), the eelpout (Gymnelis viridis), and the four-horned sculpin (Myoxocephalus quadricornis). Fish eggs were collected in August and again in March, 1979. In March, thousands of eggs were found attached to kelp stipes, wire flags, and anchor lines. As numerous tiny liparid like fish were also observed, these eggs might have been laid by adult Liparis females. The greater number of fish species collected in November is more likely a reflection of an improved and concentrated collection effort than an actual absence of these fish in August.

Taxonomic Discussion

In the following section the major sources used to identify the organisms are listed and some taxonomic problems relevant to this study are discussed.

PORIFERA

Koltun, V. M. 1959b. Siliceous-horny sponges of the Northern and Far Eastern Seas of the USSR; Order Cornacuspongida. Akademiia Nauk SSSR. Zoologicheskii Institut. Opredeliteli po Faune SSSR 67:1-235.

DeLaubenfels, M. 1953. Sponges of the Alaskan Arctic. Smithsonian Misc. Collections 121(6):1-22.

Choanites lutkenii was not included in Koltun's work, although it is one of the most common species found in this study. However, DeLaubenfels does describe it well in his paper. A sponge similar in character to the genus Suberites was collected frequently off rocks and algae yet did not key out. The megascleres are of one type and rounded on both ends, one end being larger than the other. There are no microscleres present.

CNIDARIA

Hydrozoans

Naumov, D. V. 1960. Hydroids and Hydromedusae of the USSR. Akademiia Nauk SSSR. Zoologicheskii Institut. Opredeliteli po Fauna SSSR. 70 p.

Calder, D. R. 1970. Thecate Hydroids from the shelf water of Northern Canada. J. Fish. Res. Bd. Can. 27(9):1501-1547.

Calder, D. R. 1972. Some Athecate Hydroids from the shelf water of Northern Canada. J. Fish. Res. Bd. Can. 29(3):217-288.

A frequently collected hydroid keyed out very well to Thuiaria uschakovi in Naumov's Key. However, this species is only know from the Western Russian Arctic and thus has been listed here as Thuiaria sp. A single specimen of Corymorpha keys out perfectly to C. nutans in Naumov but again, its known distribution does not include the Beaufort Sea area so is listed as Corymorpha sp. Several specimens of what Calder calls Tubularia regalis were collected. These specimens are very similar to Tubularia indivisa but have distinctly ridged gonopores. These ridges are also visible in a close-up underwater photograph when the animal was alive.

Anthozoans

(Actinaria)

Carlgren, O. H. 1949. A survey of the Ptychodactiaria, Corallimorpharia, and Actinaria; with preface by T. A. Stephenson. Svenska Vetenskaps-Akademien Handlingar, Ser. 4, 1(1).

Carlgren, O. H. 1940. Actinaria from Alaska and Arctic Waters. J. Wash. Acad. Sci. 30(1):21-27.

Carlgren, O. H. 1934. Some Actinaria from Bering Sea and Arctic Waters. J. Wash. Acad. Sci. 24:348-353.

Verrill, A. E. 1922. Alcyonaria and Actinaria. Canadian Arctic Expedition, 1913-1918. Report. Vol. 8: Mollusks, Echinoderms, Coelenterates, etc. Pt. G. King's Printer, Ottawa. 164 p.

Listed above are the sources used in an attempt to identify the numerous actinarians collected and photographed. After a careful study of the source descriptions and the samples we did not feel qualified to identify any of the animals. This group needs further taxonomic study before these organisms can be correctly identified.

(Alcyonaria)

Verrill, A. E. 1922. Alcyonaria and Actinaria. Rept. Can. Arctic Exped., 1913-1918. Vol. 8: Mollusks, Echinoderms, Coelenterates, etc. Pt. G. King's Printer, Ottawa. 164 p.

Scyphozoa

Mayer, A. G. 1910. Medusae of the World. Vol. III. The Scyphomedusae. Carnegie Inst. Wash. Publ. 109:499-735.

ANNELIDA

Polychaeta

Ushakov, P. V. 1955. Polychaeta of the Far Eastern Seas of the USSR. Azdatel'stvo Akademiia Nauk SSSR. Moskva-Leningrad. 419 p.

Fauchauld, K. 1977. The Polychaete Worms. Definitions and Keys to the Orders, Families and Genera. The Allan Hancock Foundation. Univ. of Southern Calif. 188 p.

Banse, K. and Hobson, K. 1974. Benthic Errantiate Polychaetes of British Columbia and Washington. Fish. Res. Bd. Can., Bulletin 185. 111 p.

Banse, K. and Hobson, K. Benthic Sedentariate Polychaetes of British Columbia and Washington. Unpublished.

Spirorbis are very common on the rocks in this study areay. The calcareous tubes of several animals were dissolved in order to key them out to Spirorbis granulates. It is very probable that other species are represented in the boulder patch region.

MOLLUSCA

Polyplacophora

Yakouleva, A. M. 1952. Shell-bearing mollusks (Loricata) of the Seas of the USSR. Izdatel 'stvo Akademic Nauk SSSR. Moskva-Leningrad.

Gastropoda

MacGinitie, N. 1959. Marine mollusca of Point Barrow, Alaska. U.S. Nat. Mus. Proc. 109.

Keen, M. A. and Coan, E. 1974. Marine molluscan genera of Western North America. Stanford Univ. Press.

Macintosh, R. A. 1976. A guide to the identification of some common Eastern Bering Sea snails. Northwest Fisheries Center. NOAA. Kodiak, Alaska.

Nora Foster from the University of Alaska's Institute of Marine Science in Seward, determined the names Margaritas vorticifera, Neptunea borealis and Onchioiopsis borealis when shown the respective animals.

Nudibranchia

No comprehensive works covering Arctic species were found for this group with which taxonomic identifications could be made.

Pelecypoda

Bernard, F. R. Bivalve mollusks of the Western Beaufort Sea. Unpublished.

MacGinitie, N. 1959. Marine mollusca of Point Barrow Alaska. U.S. Nat. Mus. Proc. 109.

PYCNOGONIDA

Hedgpeth, J. W. 1963. Pycnogonida of the North American Arctic. J. Fish. Res. Bd. Can. 20(5):1315-1348.

CRUSTACEA

Isopoda

Richardson, H. 1905. Monograph on the Isopods of North America. Bull. U.S. Nat. Mus. 54:727.

Amphipoda

These identifications were made by Hal Koch and Mark Childers at Western Washington University's Arctic Marine Laboratory.

Decapoda

Rathbun, M. J., H. Richardson, S. J. Holmes, and L. J. Cold. 1910. Harriman Alaska Expedition. vol. 10. Crustacea. Smithsonian Institution Wash. D.C. No. 1997, 337 p.

BRYOZOA

Kliuge, G. A. 1962. Bryozoa of the Northern Seas of the USSR. Sharma, B. R. (Trans.) 1975. Smithsonian Institute, Washington, D.C. 735 p.

Osburn, R. C. 1950. Bryozoa of the Pacific Coast of America. Part 1, Cheilostomata--Anasca. Allan Hancock Pac. Exped. 14(1):1-269.

Osburn, R. C. 1952. Bryozoa of the Pacific Coast of America. Part 2, Cheilostomata--Ascophora. AlIan Hancock Pac. Exped. 14(2):271-611.

George Meuller at the University of Alaska's Institute of Marine Science in Seward, worked with us in identifying marry of the bryozoans collected.

The species listed as Flustrella sp. did not key out with the above literature. Each colony is 9-11 cm tall and 4-5 mm in diameter. They are dark brown, very rough, and occur in groups.

ECHINODERMATA

Asteroidea

D'yakonov, A. M. 1950. Sea Stars of the USSR Seas. Izdatel'stvo Akademii Nauk SSSR. Moskva-Leningrad.

Grainger, E. H. 1966. Sea Stars (Echinodermata: Asteroidea) of Arctic North America. Fish. Res. Bd. Can., Bulletin 152. 70 p.

Two specimens of a particular sea star were collected, but identified only to Pedicellasteridae. They were small, had a very open skeleton, straight and crossed pedicellaria, but only two rows of tubefeet the whole arm length.

CHORDATA

Ascidiacea

Van Name, W. G. 1945. North and South American Ascidians. Bull. American Museum of Natural History 84:1-476.

Berrill, N. J. 1950. The Tunicata. With an Account of the British Species. Ray Society, London. 354 p.

VERTEBRATE

Osteichthyes

McAllister, D. E. Keys to the Species of Marine Waters of Arctic Canada. Unpublished house key of the consulting firm LGL.

A key from the University of Alaska's Institute of Marine Science on the species of *Liparis*. Unpublished.

The species *Liparis herschelinus* and several other species (*L. bristolense*, *L. lapteria*, *L. dubins*) have not been adequately worked out. They are very similar to each other with unclear taxonomic differences.

PHAEOPHYTA (brown algae) and RHODOPHYTA (red algae)

Abbot, I. A. and G. J. Hollenberg. 1976. Marine algae of California. Stanford University Press, Stanford. 827 p.

Burrows, E. M. 1964. An experimental assessment of some of the characters used for specific delimitation in the genus *Laminaria*. J. Mar. Biol. Ass. U.K. 44:137-143, 2 pls.

Chihara, M. 1967. Some marine algae collected at Cape Thompson of the Alaskan Arctic. Bull. Nat. Sci. Mus. Tokyo 10(2):184-200, 4 pls.

Collins, F. S. 1927. Marine algae from Bering Strait and Arctic Ocean collected by the Canadian Arctic Expedition, 1913-1916. Report of the Canadian Arctic Expedition 1913-1916. 4(B). p. 3-16.

Druehl, L. D. 1966. Taxonomy and distribution of northeast Pacific species of Laminaria. Can. J. Bet. 46:539-547, 7 pls.

Farlow, W. G. 1886. Notes on Arctic algae; based principally on collections made at Ungava Bay by Mr. L. M. Turner. Proc. Am. Acad. Arts and Sci. 21(2):469-477.

Jónsson, H. 1904. The marine algae of East Greenland. Medd. om Grønland 30(1):1-73.

Kjellman, F. R. 1883. The algae of the Arctic Sea. Kongliga Svenska Vetenskaps-Akademiens Handlingar 20(5):1-349, 31 pls.

Kjellman, F. R. 1889. Om Beringhafvets Algflora. Kongliga Svenska Vetenskaps-Akademiens Kandlingar 23(8):1-58, 7 pls.

Lee, R. K. S. 1973. General ecology of the Canadian Arctic benthic marine algae. Arctic 26:32-43.

Mann, K. H. 1971. Relation between stipe length, environment, and the taxonomic characters of Laminaria. J. Fish. Res. Bd. Can. 28(5]:778-780.

Mohr, J. L., N. J. Wilimousky, and E. Y. Dawson. 1957. An Arctic Alaskan kelp bed. Arctic 10:45-52.

Newroth, P. R. 1971. The distribution of Phyllophora in the North Atlantic and Arctic regions. Can. J. Bet. 49:1017-1024.

Newroth, P. R. and J. W. Markham. 1972. Observations on the distribution, morphology, and life histories of some Phyllophoraceae. Proc. Int. Seaweed Symp. 7:120-125.

Rosenvinge, L. K. 1910. On the marine algae from northeast Greenland (N. of 76°N. Lat.) collected by the "Danmark Expedition." Medd. om Grønland. 43(4):91-133.

Rosenvinge, L. K. 1923-24. The marine algae of Denmark. I. Rhodophyceae. Kgl. Danske Vidensk. Selsk. Skr., Naturv. og Mathem. Afd., 7. Raekke 7(3):285-487, pls. 5-7.

Widdowson, T. B. 1971. A taxonomic revision of the genus Alaria Greville. Syesis 4:11-49.

Widdowson, T. B. 1973. The marine algae of British Columbia and northern Washington: revised list and keys. Part I. Phaeophyceae (Brown Algae). Syesis 6:31-96.

Widdowson, T. B. 1974. The marine algae of British Columbia and northern Washington: revised list and keys. Part II. Rhodophyceae (Red Algae). Syesis 7:143-186.

Wilce, R. T. 1959. The marine algae of the Labrador Peninsula and northwest Newfoundland (ecology and distribution). National Museum of Canada, Bulletin 158. 103 p., 11 pls.

Wilce, R. T. 1965. Studies in the genus Laminaria. III. A revision of the North Atlantic species of the Simplices Section of Laminaria. In: Proceedings of the 5th Marine Biological Symposium. Ed. Tore Levring. Göteber.

Zinova, A. D. 1953. [Determination book of the brown algae of the northern seas of the USSR]. Leningrad and Moscow. (Original in Russian.) 223 p.

Zinova, A. D. 1955. [Determination book of red algae of the norther seas of the USSR]. Leningrad and Moscow. (Original in Russian.) 219 p.

Listed above are the sources used in identifying the red and brown algae collected in this study. Our appreciation to Dr. Maurice Dube of the Department of Biology at Western Washington University who provided some taxonomic assistance and to Dr. Robert T. Wilce of the Department of Botany at the University of Massachusetts who confirmed several of our identifications.

Kjellman's (1883) description and illustration of *Rhodomela lycopodioides* f. *flagellaris* fits our specimen closely. However, Rosenvinge (1923-24) treats this species and two others, *R. virgata* and *R. subfusca*, as forms of one species, R. subfusca. This view is presently accepted by Dr. Wilce, an authority on Arctic algae, thus our determination, R. subfusca f. lycopodioides.

Several Laminaria specimens were collected with a branched holdfast and occasionally one or two constrictions in the frond. These specimens were determined as L. saccharin by Dr. Wilce who explained that the constrictions were probably a result of the growth habit of the plant. From our recent observations on the growth of L. solidungla and L. saccharin we are inclined to agree. We also have collected specimens of both species which possessed a branched stipe that gave rise to two fronds.

Ecology of the Stefansson Sound Kelp Community: Preliminary Results of Winter Studies

At the close of the 1978 summer field season several in situ biological experiments were initiated at DS-11. These experiments were to be monitored through the 1978-1979 winter and were designed to: (1) determine the seasonal growth rates of Laminaria, (2) determine the amount of organic matter these plants contribute to the Arctic environment, (3) determine the species composition and rate of recolonization on denuded rock surfaces, and (4) to observe patterns of development or "succession" on denuded rock surfaces. In conjunction with this work we collected quantitative data on algal and attached invertebrate biomass, sedimentation rates, benthic infaunal densities and biomass, and made qualitative observations on the physical and biological environment during each sampling period. In the following discussion the preliminary results of the experiments and observations made by the divers are reported.

The biggest surprise of this study to date was the substantial growth of Laminaria solidungla between November, 1978 and February, 1979. This was unexpected since the plants were in complete darkness and had grown very little during the previous fall when light was believed to be available. The average growth of Laminaria from mid August to mid November, 1978, was 1.5 cm (ranges were from 0 to 2 cm from 20 plants) compared to an average growth of 7 to 10 cm (ranges were from 5 to 22 cm from 60 plants) between mid November, 1978 and early March, 1979, A new constriction was also produced in the frond during this period. It is believed that the constrictions in this plant are produced once a year, and that the area between constrictions represent a year's growth. This winter growth occurred in virtual darkness since DS-11 is characterized by an extremely thick and dirty ice cover which is almost impenetrable to light. This suggests these algae either; (1) are growing from stored nutrient reserves, or (2) are assimilating sources of carbon in their surrounding environment, i.e., are heterotrophic. New experiments, initiated in May and carried through the following winter, should answer this question. Finally in view of the stable nature of the community, a net export of organic matter to the marine environment equal to the production of new algal biomass should be considered.

In March, 1979 the biomass of the attached plant and animal biota was determined by denuding several 1/4 m^2 quadrats using a diver operated airlift. The kelps Laminaria solidungla and L. saccharin constituted over 95% of the total biomass. The biomass of Laminaria, corrected to 100 percent cover, was calculated at 3.287 ± .588 kg/m^2 (N=4). In Table 3.6 this figure is compared to the biomass of Laminaria in kelp communities on the northeast and west coasts of North America and to the biomass found in other Beaufort Sea nearshore regions.

The underice cover at DS-11 was unique in comparison to the underice features seen by the divers in other locations. It was characterized by a rough and dirty layer of soft slushy ice, ranging from .5 to 2 meters in thickness (Fig. 3.9). In March, 1979 many amphipods and scaleworm polychaetes, and some Arctic cod were seen in close association with this underice cover. No organisms were seen associated with the common smooth, hard underice regions. The structure and appearance of this slushy ice has prompted much speculation that the formation could be a result of anchor ice formation (for a discussion see Reimnitz and Dunton, 1979).

A comparably low amount of sediment accumulated between November and early March, 1979 compared to the August to November period. Sediment accumulations averaged 1-2 mm this winter compared to 2.5 - 5 mm last fall (Fig. 3.10). Water visibility increased from less than 2 meters in November to over 7 meters in March. Slight water currents were also observed in March.

TABLE 3.6. Comparison of the Stefansson Sound kelp community to kelp communities on the east and west coasts of North America and to other Beaufort Sea regions.

Location	Depth (m)	Mean Biomass kg/m^2	Benthic Community Components	Equipment	Source
Stefansson Sound, AK, DS-11	5.5	3.287	*L. solidungla* *L. saccharin*	SCUBA	This study
Coast of Nova Scotia, Canada	3-13	16.012	*L. digitata* *L. longicruris*	SCUBA	Mann, 1972
Puget Sound, WA	4-6	1.5-3.5	*L. saccharin* *Alaria spp.*	SCUBA	Webber & Smith, unpub.
Foggy Bay, Stefansson Sound, AK Station G3C	5	.0104	Polychaetes Molluscs Crustaceans	Smith-McIntyre grab	Broad, et al., 1979
West Stefansson Sound, AK Station HØB	5	.0189	Polychaetes Molluscs Crustaceans	Smith-McIntyre grab	Broad, et al., 1979
Prudhoe Bay, AK	3.7	.0158	Polychaetes Molluscs	SCUBA	Dunton, 1979a
Prudhoe Bay, AK	1.7	.0019	Polychaetes Molluscs	SCUBA	Feder and Schamel, 1976

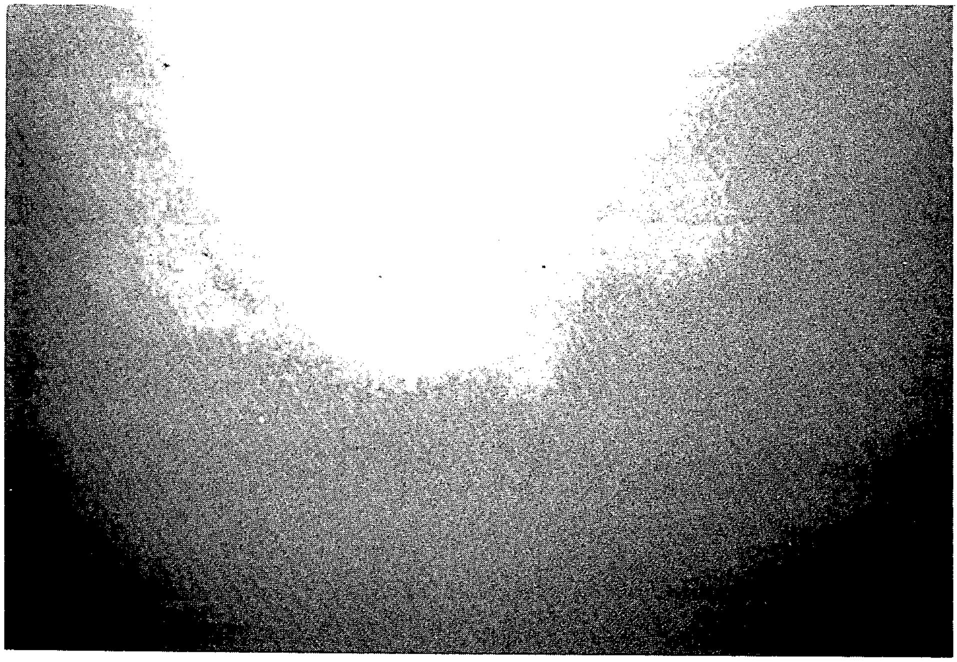


Fig. 3.9. A photograph of the underice surface at DS-11 showing a rough and dirty ice undersurface.

Fig. 3.10. A photograph taken at DS-11 in November showing the sediment accumulation on the kelp and poor visibility.

Hydroids appear to be the first colonizers on experimental plots denuded in August, 1978. They were small (to 1 cm high) and scattered on the rock surfaces, but absent in areas of remaining Lithothamnium cover. Lithothamnium is widespread in the community and appears to force most algae and invertebrates into competition for small pockets of unused rock substrate (Fig. 3.4 and 3.8).

CONCLUSIONS

The Stefansson Sound kelp community appears to be similar in many respects to kelp communities at more temperate latitudes. It is characterized by; (1) an abundant and diverse flora and fauna, (2) a high utilization of the rock substrate and competition between species for space, (3} a kelp overstory of high biomass consisting of Laminaria spp., (4) an algal understory of several red algal species and attached invertebrate species, and (5) an apparently productive kelp community with an unknown export of an organic matter to the marine ecosystem.

The list of animal and plant species of the Stefansson Sound kelp community is by no means complete. New species are continually being found as taxonomic problems are worked out and collection techniques on rock surfaces improve. Much remains to be learned in regard to the growth of the algae in the spring and summer period, their means of growth, and times of reproductivity. In the next year recolonization studies should provide data on the ability of the community to re-establish itself following physical disturbances at different times. Finally, it is hoped that answers to questions involving the trophic structure and the overall importance (or non-importance) of this community to the Arctic ecosystem are reached.

SUMMARY OF 4th QUARTER

A. Field Activities

1. Field Trip Schedule

a. **February 21:** Dive team **arrives** in Deadhorse.

b. February 22-25: Locate DS-11, cut dive hole. **NARL airlift of parcoll and** field **supplies on February '24.** Parcoll **installation** completed on February 25. Travel by NOAA and ERA (206) helicopter.

c. February 26-27: Conduct benthic and underice sampling program for LGL (RU-467) on additional OCS contract funding. Travel by NOAA helicopter.

d. February 28-March 1: Divers collect mysids and amphipods for Dave Schneider (RU-356) for laboratory studies. Travel by NOAA helicopter.

e. March 2-6: Extremely cold and windy weather. No field work conducted.

f. March 7-8: Divers work with Dr. Erk Reimnitz (USGS RU-205) on ice features, and collect data on _in situ_ benthic experiments.

g. March 9: Collect benthic and underice samples and deploy experimental equipment for Dr. Andrew Carey (RU-6) on contract funding. Travel by NOAA helicopter.

h. March 10-13: Divers continue benthic ecological work--collect data on sedimentation, recolonization and growth experiments. Travel by NOAA helicopter.

i. March 14: Complete sampling for Carey (RU-6) and retrieve experimental equipment (on contract funding). Retrieve sampling bottles for Don Schell (RU-537). Release bottom current drifters for Reimnitz (RU-205). Terminate dive program. Dismantle and pack parcoll for NARL. Travel by NOAA helicopter.

j. March 15: Dive team departs Deadhorse for Bellingham, Washington.

2. Scientific Party

a. Assistant Investigator and Team Leader: Ken Dunton, on salary.

b. Marine Technician* and SCUBA divers:

John R. Olson, on contract
*Paul D. Plesha, on contract
Gary Frederick Smith, on contract

3. Methods

See text of annual report.

4. Sample Localities

See text of annual report.

5. Data Collected

See text of annual report.

LITERATURE CITED

Broad, A. C. 1978. Environmental assessment of selected habitats in the Beaufort Sea littoral system. Environmental Assessment of the Alaska Continental Shelf. Quarterly Report, September, 1978. Nat. Oceanic Atmos. Admin., Boulder, Co. 17 p.

Broad, A. C., H. Koch, D. T. Mason, G. M. Petrie, D. E. Schneider, and R. J. Taylor. 1978. Environmental assessment of selected habitats in the Beaufort Sea littoral system. Environmental Assessment of the Alaskan Continental Shelf. Annual Report. Nat. Oceanic Atmos. Admin., Boulder, Co. 86 p.

Collins, F. S. 1927. Marine algae from Bering Strait and Arctic Ocean collected by the Canadian Arctic Expedition, 1913-1916. Report of the Canadian Arctic Expedition 1913-1916. 4(B). p. 3-16.

Crane, J. J. and R. T. Cooney. 1974. The nearshore benthos. In: V. Alexander, et al. (eds.) Environmental Studies of an Arctic Estuarine System, Final Report. Univ. Alaska, Inst. Mar. Sci. Rept. R74-1:411-466.

Dunton, K. H. 1979a. A survey of the biota and physical characteristics of the Exxon Ice Island Site in Prudhoe Bay, Alaska. Unpubl. Rept. to Exxon, USA. April, 1979. 29 p.

Dunton, K. H. 1979b. A diving study of an Arctic kelp community in the Beaufort Sea. Alaska Magazine 45(6): In Press. (Anticipated June, 1979.)

Feder, H. M. and D. Schamel. 1976. Shallow water benthic fauna of Prudhoe Bay. In: D. W. Hood and D. C. Burrell (eds.) Assessment of the Arctic Marine Environment, Selected Topics. Univ. Alaska, Inst. Mar. Sci. Occ. Publ. No. 4:329-359.

Kjellman, F. R. 1883. The algae of the Arctic Sea. Kongliga Svenska Vetenskaps-Akademiens Handlinger 20(5):1-349, 31 pls.

Leffingwell, E. de K. 1919. The Canning River region, northern Alaska. U.S. Geol. Survey Prof. Paper 109. 251 p.

Mann, K. H. 1972. Ecological energetic of the seaweed zone in a marine bay on the Atlantic coast of Canada. I. Zonation and biomass of seaweeds. Marine Biology 12:1-10.

Mohr, J. L., N. J. Wilimousky, and E. Y. Dawson. 1957. An Arctic Alaskan kelp bed. Arctic 10:45-52.

Reimnitz, E. and K. Dunton. 1979. Diving observations on the soft ice layer under the fast ice at Dive Site 11 in the Stefansson Sound boulder patch. In: Barnes, P. and E. Reimnitz. The Geological Environment of the Beaufort Sea Shelf and Coastal Regions. Annual Report, April, 1979. Nat. Oceanic Atmos. Admin., Boulder, Co. Attachment D.

Reimnitz, E. and R. Ross. 1978. The Flaxman boulders in Stefansson Sound: a survey of the boulder patch. In: Barnes, P. and E. Reimnitz. Geologic Processes and Hazards of the Beaufort Sea Shelf and Coastal Regions. Quarterly Report, December 1978. Nat. Oceanic Atmos. Admin., Boulder, Co. Attachment B. 10 p.

Reimnitz, E. and L. Toimil. 1976. Diving notes from three Beaufort Sea sites. In: Barnes, P. and E. Reimnitz. Geologic Processes and Hazards of the Beaufort Sea Shelf and Coastal Regions. Quarterly Report, December, 1976. Nat. Oceanic Atmos. Admin., Boulder, Co. Attachment J. 7 p.

This arrangement allowed fecal pellets to fall through the screen to the bottom of the beaker where they could be more easily separated from food particles. After a known period of exposure to the food, the animals were removed to clean Millipore filtered seawater and allowed to remain there for 24 hours to clear their guts. Fecal pellets were removed from the feeding and gut clearance chambers with a Pasteur pipette, transferred to a thin strip of 121$_{\mu}$ nitex screen. The screen and pellets were blotted on filter paper and briefly rinsed three times with distilled water. Pellets were then transferred to a pre-ashed and tared aluminum foil pan, dried at 60"C for at least 12 hours, and weighed to the nearest 0.01 mg on a Cahn model DTL electrobalance. Dry pellets and pans were then ashed in a muffle furnace at 500°C for either 2 or 24 hours and reweighed. It was found that there was no further decrease in weight when a 2 hour ashed sample was further ashed for 24 hours. Food remaining after the feeding period was recovered by suction filtration (<1/3 atmosphere) on pre-ashed (475°C for 30 minutes) and tared 2.4 cm Whatman GF/c glass fiber filters, rinsed twice with 2 ml of distilled water, dried for at least 12 hours at 60°C, and weighed on a Cahn model DTL electrobalance. Dry filters and food were then ashed in's muffle furnace at 500°C for either 2 or 24 hours, and reweighed.

Food ingested was calculated as the difference in dry weights of the initial and recovered food. Percent organic content of initial food and recovered fecal pellets was calculated from the ash-free weights and the unashed dry weights. These values were then used to calculate two different assimilation efficiencies. Gravimetric assimilation efficiency was calculated using the relationship

$$u' \left(\frac{I - N}{I}\right) \times 100$$

where U is the percentage of assimilation, I is the dry weight ingested, and N is the dry weight excreted as feces. This efficiency measures total assimilation which includes both organic matter and ash. Organic assimilation was calculated using Conover's (1966) equation.

$$U' = \left(\frac{(F' - E')}{(1 - E')\ F'}\right) \times 100$$

size fractions used in experiments. The following screen sizes were used: 63P, 102µ, 202µ, 425µ, and 1050µ, or 1163µ. Sieved samples were stored in Millipore filtered seawater in a 4°C incubator under a 24 hour photoperiod until used.

Assimilation Experiments

All of the assimilation experiments employed the following procedure. The quantity of food ingested during the experimental feeding period was estimated by determining the difference in dry weight between initial and recovered food. Dry weights for initial food could not be directly determined without destroying the natural microflora associated with the food. Instead two different procedures were used to estimate the initial amount of food offered to each animal. In experiments where a small food particle size was used, a fixed volume of a constantly stirred heavy suspension of the particles was delivered to each experimental chamber with a wide bore automatic pipette. At least 10 control samples were delivered into separate containers for immediate dry weight and ash weight analysis to provide an estimate of the amount of food delivered to the experimental chambers. In experiments where a coarse peat particle size was used, a small quantity of peat (about 40-50 mg damp weight) was rolled into a ball and pressed between two sheets of Whatman No. 1 filter paper for one minute using the two halves of a petri dish. The blotted samples were then rapidly weighed to the nearest 0.1 mg and were placed in the experimental chambers. At least 10 control samp-es were similarly prepared for direct dry weight and ash weight analysis. The control samples were used to provide a damp to dry weight conversion factor to allow estimates of the dry weights placed in each chamber.

Animals that had been starved long enough to allow complete evacuation of their guts were individually placed in separate experimental chambers containing the initial food ration and Millipore filtered sea water. Experiments on fine peat particle sizes were carried out in 100 ml beakers containing about 70 ml of seawater. The chambers used for large food particle sizes were 250 ml beakers containing about 200 ml of Millipore filtered seawater with a 1163µ nitex screen shelf about halfway up the beaker.

Results and Discussion

Fecal Pellet Composition

The composition of freshly collected fecal pellets was examined using the standardized observation procedure described in the methods section. The mean number of items was computed for each recognizable food category. These values were then used to calculate the percent composition of the fecal pellets. The results for those species in which five or more pellets were examined are presented in Figs. 4.1 to 4.8. For those species in which fewer than five pellets were examined, the results appear in Table 4.1.

Most of the species studied ingest substantial numbers of diatoms and at least some peat. Since many of the diatoms observed are benthic and most of the pellets contained a high proportion of mineral grains, deposit feeding may be important in a number of these species. A smaller proportion of the species ingest crustaceans (53%) and polychaetes (32%), however most of these appear to be omnivorous because diatoms and peat are often major dietary components. Whether those crustaceans and polychaetes that were ingested were captured alive or as detritus is not known. Observations of mysids and many of the amphipods under laboratory feeding situations indicate that these species will readily consume dead animal tissue. The most striking feature of these data is that there is considerable dietary overlap between the species. None of the species studied appear to be trophic specialists. However there is some indication of different patterns of food selection. For instance, Mysis littorals, Gammarus setosus and perhaps Haploscoloplos elongatus appear to ingest substantially more peat than the other species studied. Mysis littorals, Onisimus litoralis, Acanthostephia behringensis, Gammaracanthus loricatus, and Myoxocephalus quadricornis all ingest more crustaceans than the other species. Saduria entomon, Myoxocephalus quadricornis, and perhaps Haploscoloplos elongatus feed heavily on polychaetes. The high proportion of diatoms ingested indicates that primary production of the benthic microalgae is an important source of energy input for the arctic shallow water marine ecosystem, at least during the summer when these pellets were collected.

Fig. 4.1. Fecal pellet composition of the mysid *Mysis litoralis*. The percent composition is based upon the mean number of recognizable food items observed in 34 fecal pellets.

PD · Pennate diatoms
CD · Centric diatoms
DC = Diatom chains
AR = *Amphipleura rutilans* - a colonial benthic diatom
FA = Filamentous algae
D = Dinoflagellates
P = Peat including plant fibers
CF = Crustacean fragments
Ps = Polychaete setae
SS = Sagitta (Chaetognath) setae

Fig. 4.1. Fecal pellet composition of the amphipod *Gammarus setosus*. The percent composition is based upon the mean number of recognizable food items observed in 24 fecal pellets. Figure labels as in Fig. 4.1.

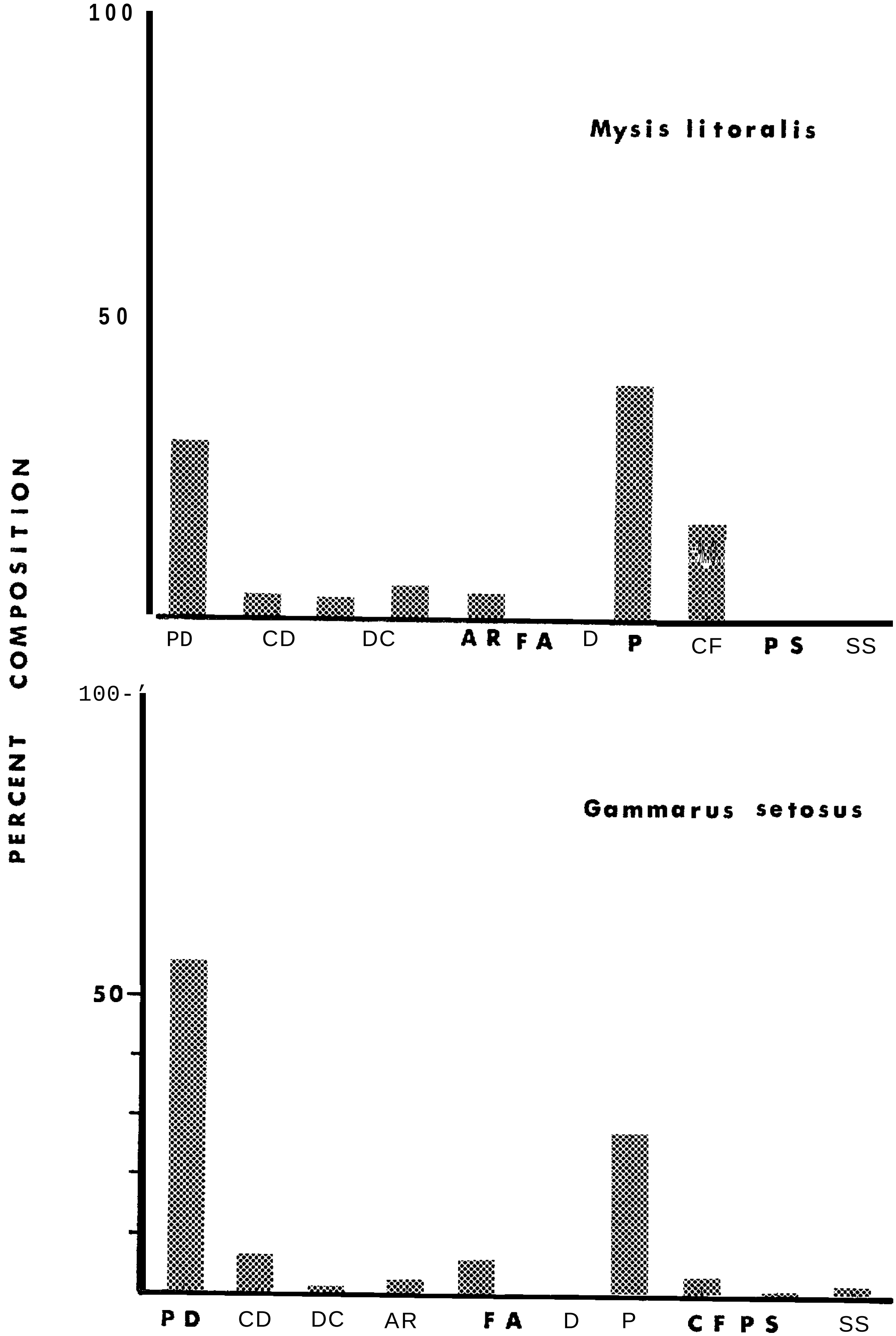

PERCENT COMPOSITION
100
50
Mysis litoralis
PD
CD
DC
AR
FA
D
P
CF
PS
SS
100
50
Gammarus setosus
PD
CD
DC
AR
FA
D
P
CF
PS
SS

Fig. 4.3. Fecal pellet composition of the amphipod <u>Onisimus litoralis</u>. The percent composition is based upon the mean number of recognizable food items observed in 17 fecal pellets. Figure labels as in Fig. 4.1.

Fig. 4.4. Fecal pellet composition of the amphipod <u>Apherusa glacialis</u>. The percent composition is based upon the mean number of recognizable food items observed in 19 fecal pellets. Figure labels as in Fig. 4.1.

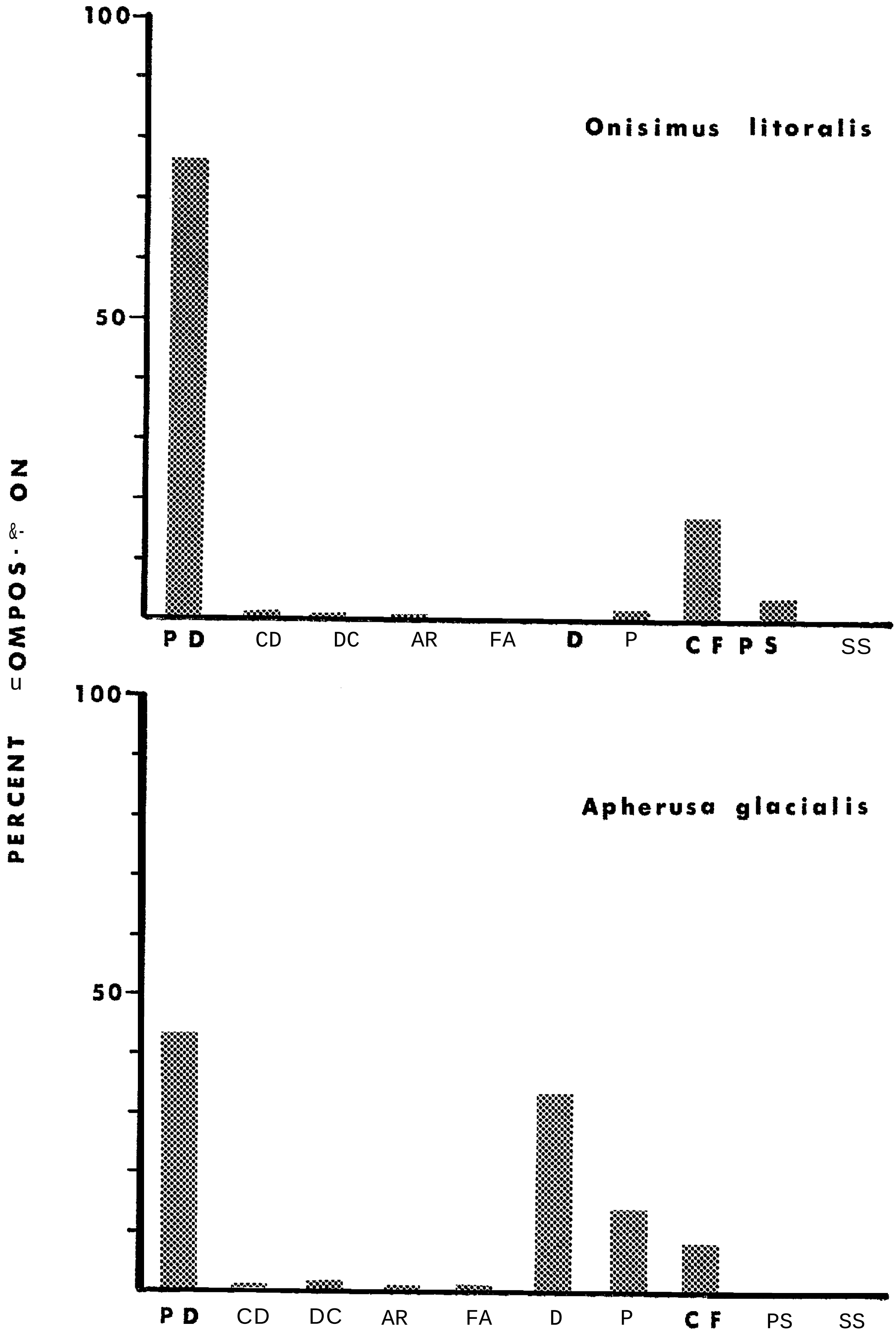

100
50
Onisimus litoralis
PD
CD
DC
AR
FA
D
P
CF
PS
SS
PERCENT
100
50
Apherusa glacialis
PD
CD
DC
AR
FA
D
P
CF
PS
SS

Fig. 4.5. Fecal pellet composition of the isopod *Saduria entomon*. The percent composition is based upon the mean number of recognizable food items observed in 15 fecal pellets. Figure labels as in Fig. 4.1.

Fig. 4.6. Fecal pellet composition of the polychaete *Terebellides stroemi*. The percent composition is based upon the mean number of recognizable food items observed in 12 fecal pellets. Figure labels as in Fig. 4.1.

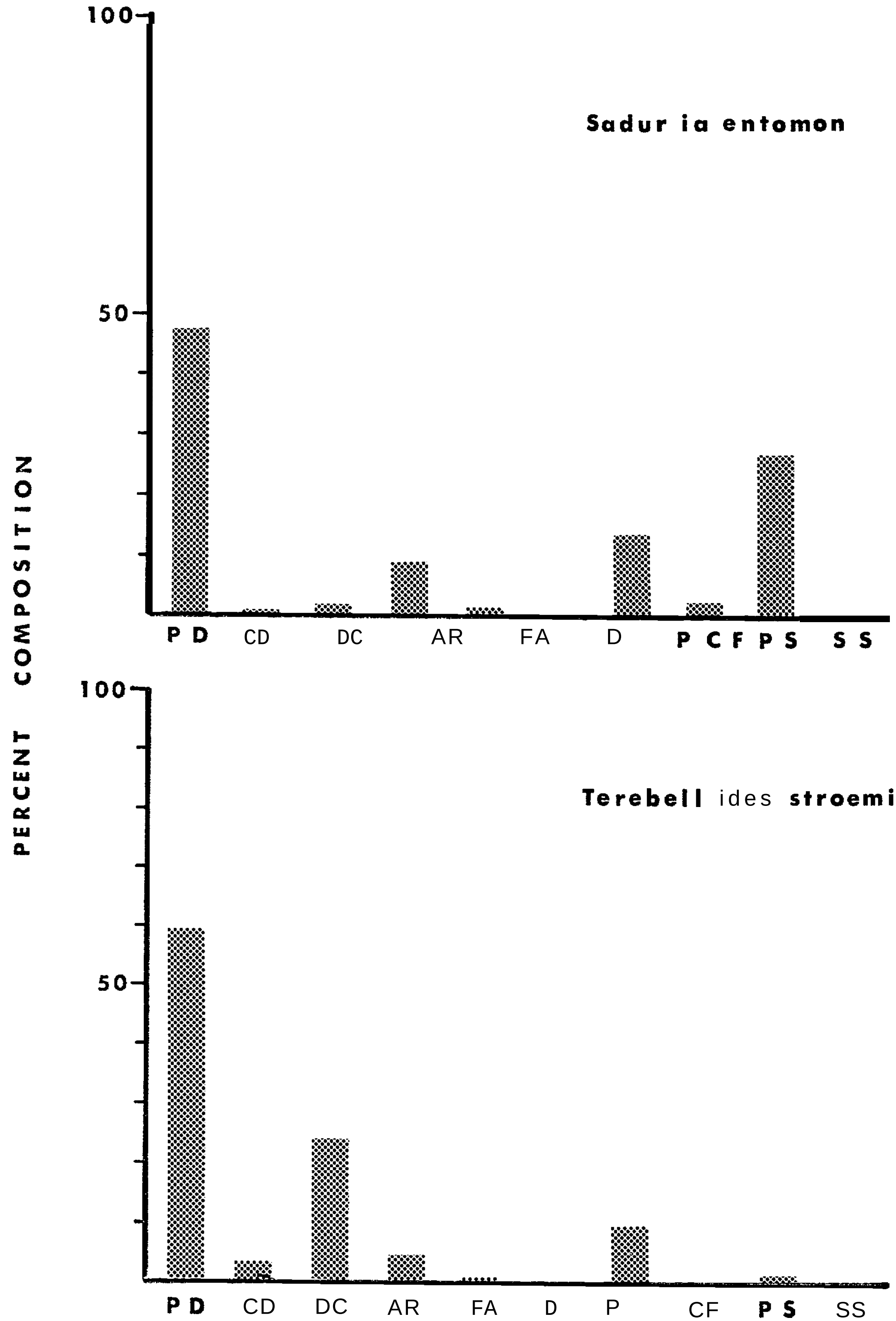
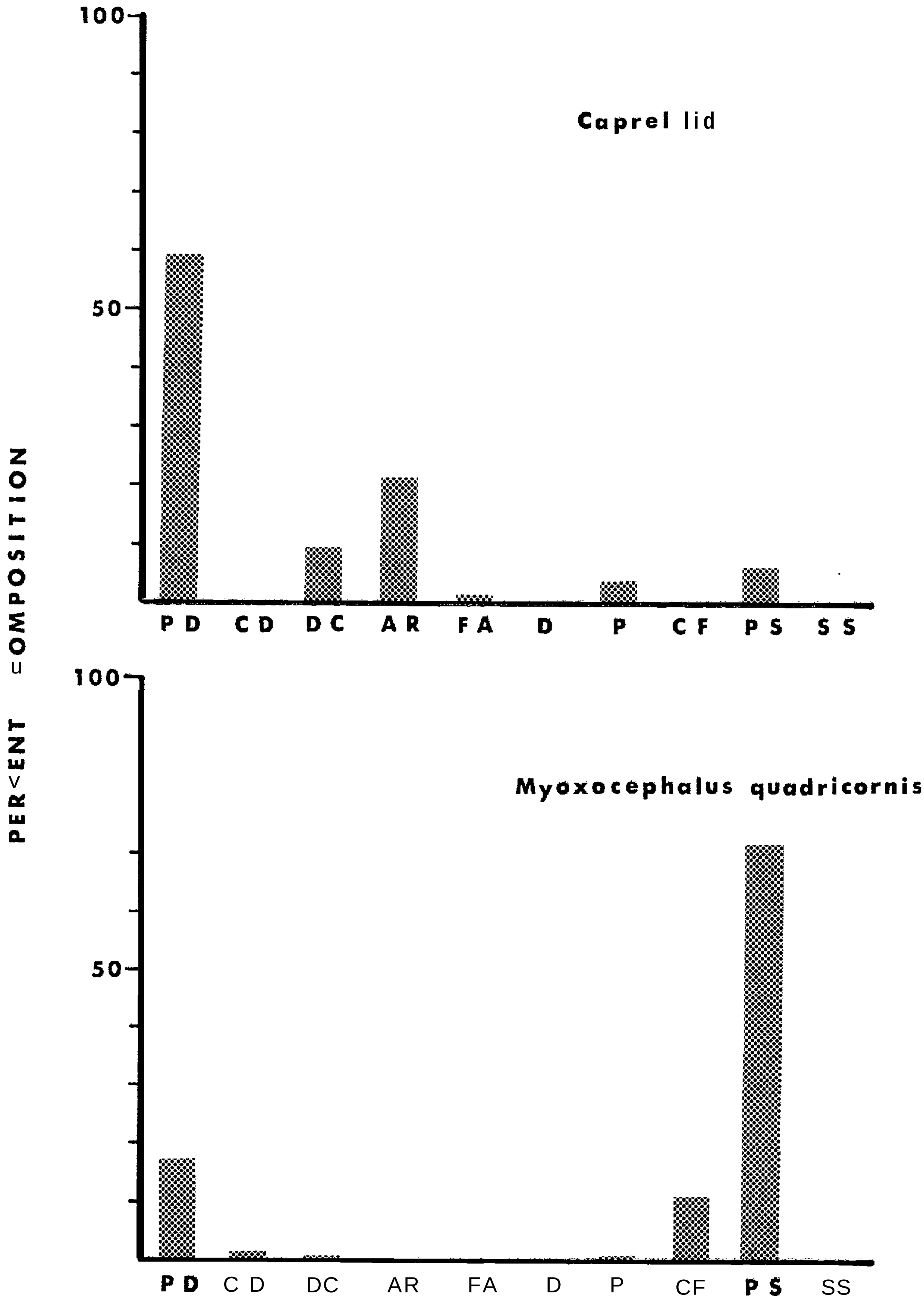

100
50
PERCENT COMPOSITION
Sadur ia entomon
P D
CD
DC
AR
FA
D
P C F
P S
S S
100
50
Terebell ides stroemi
P D
CD
DC
AR
FA
D
P
CF
P S
SS

Fig. 4.7'. Fecal pellet composition of the caprellid *Caprella sp*. The percent composition is based upon the mean number of recognizable food items observed in 5 fecal pellets. Figure labels as in Fig. 4.1.

Fig. 4.8. Fecal pellet composition of the fish *Myoxocephalus quadricornis*. The percent composition is based upon the mean number of recognizable food items observed in 17 fecal pellets. Figure labels as in Fig. 4.1.



100
50
Caprel lid
PD
CD
DC
AR
FA
D
P
CF
PS
SS
PER<ENT COMPOSITION
100
50
Myoxocephalus quadricornis
PD
CD
DC
AR
FA
D
P
CF
PS
SS

Table 4.1. Percent of Recognizable Food Items in Fecal Pellets. Percentages are based upon the mean number of food items identified per pellet using the standardized observation technique.

	Atylus carinatus	Acanthostephia behringensis	Gammaracanthus loricata	Pagurus trigonocheirus	Harmothoe imbricata	Pectinaria granulata	Haploscoploes elongatus	Scolecolepides arctius	Priapulus caudatus	Saduria sabini
Pennate Diatoms	81.6	59.1	0	84.0	81.5	91.0	34.6	28.8	48.1	50.0
Centric Diatoms	O	1.0	0	0.5	3.3	3.0	0	0.1	0	10.0
Diatom Chains	O	0	0	0	0	3.0	0	67.3	0	0
Filamentous Algae	o	0	0	0	0	1.5	0	0	0	0
Peat	10.0	4.0	11.2	0.5	0	1.5	34.6	0.7	16.2	40.0
Crustacean Fragments	8.4	35.9	88.8	15.0	5.3	0	0	0.1	0	0
Polychaete setae	0	0	0	0	0	0	30.8	3.0	35.7	0
Total Mean No. I terns	20.0	99.0	15.0	103.0	151.0	33.5	26.0	339.3	210.0	18.0
Total Pellets Examined	3	2	1	2	1	2	1	3	1	1

Gut Clearance Times

In animals that produce discrete fecal pellets, the quantitative collection of these may often be a better index of feeding activity than attempting to estimate the amount of food actually ingested. As we intended to quantitatively collect fecal pellets in some of our experiments it was necessary to determine the gut clearance times for the species used.

An experiment was set up to determine the gut clearance time for the amphipod *Gammarus setosus* using freshly collected specimens. Twenty-four *G. setosus* were placed individually in compartments of a plastic box immediately after they were collected. Each compartment contained about 50 ml of Millipore filtered sea water. Fecal pellet production was monitored at 30 minute intervals for 9.5 hours. After about 6.5 hours there was no significant increase in the number of pellets produced. The mean clearance time, calculated by averaging the times of last pellet production for each animal, was 4.9 hours and a mean of 9.2 pellets was produced during this period. In a later feeding experiment with *G. setosus* it was noted that fecal pellets began to be released about 4.5 hours after the starved animals were presented with food. These data suggest that this species requires about 4.5 to 4.9 hours to pass food completely through the gut. The design of subsequent feeding experiments took the above information into account.

A similar gut clearance experiment was set up using the amphipod *Onisimus litoralis*. Gut clearance for this species appears to be much slower than that for *G. setosus*. After 72 hours, when the experiment was terminated, only 4 animals out of 24 appeared to have cleared their guts and fecal pellets were still being slowly produced. It was concluded that *O. litoralis* was not ideal for egestion rate studies and no further experiments were planned for this species using this technique.

Sediment Feeding Experiments

Casual observations of the behavior of *Gammarus setosus* suggested that this species may ingest fine silty sediments. During the period of ice cover a layer of silt is deposited among the coarser gravel of the near-shore sediments. As the ice begins to melt away from the shore, *G. setosus* is extremely abundant in this area, often entering the interstices of the gravel sediments. Animals collected with silt laden water from this area produced large numbers of fecal pellets over a several day period. Several experiments were designed to examine the ability of this species to ingest sediments. Fine sediments contain large populations of diatoms as well as adsorbed organic material.

Unfiltered sea water containing suspended sediment that had been stirred up from the nearshore gravel was used to fill a compartmented plastic box. Individual G. setosus that had been starved for 24 to 30 hours prior to the experiment were introduced into each of the 24 compartments of the box. The box was held in a lighted incubator at 5°C during the experiment. Fecal pellet production was monitored at hourly intervals for 14 hours. After an initial lag of about 3-4 hours, pellet production was nearly linear for the duration of the experiment. At 14 hours the mean ± S.E. number of fecal pellets produced per animal was 13.0 ± 1.7.

An experiment was designed to provide information on the range of particle sizes that can be ingested by G. setosus. Silty sea water (salinity <5%) was collected by mechanically stirring up the sediments prior to taking the water sample. Small volumes of this water were passed through one of the following graded series of sieves to provide a series of solutions from which particles of different sizes had been selectively removed: (a) unsieved silty water; (b) 202µ Nitex screen; (c) 121µ Nitex screen; (d) 62µ Nitex screen; (e) 8µ Nuclepore polycarbonate membrane; and (f) 0.45µ Millipore filter. The 8µ Nuclepore membrane tended to clog so rapidly that it was necessary to prefilter this solution through Whatman No. 5 filter paper before passing it through the membrane. Even with this treatment it was necessary to change the Nuclepore membrane every 75 - 100 ml, indicating that particles >8µ were passed by the Whatman No. 5 filter.

Twelve G. setosus were placed individually in compartments of a plastic box containing about 50 ml of the above solutions. Fecal pellet production was recorded at hourly intervals for 11 hours. At each observation the pellets were removed to a second compartmented box. The accumulated pellets were briefly rinsed in distilled water and dried at 60°C for 12 hours. Pellet dry weights were determined to the nearest 0.1 mg on a Cahn DTL electrobalance. The amphipods used in this experiment were also rinsed in distilled water and dried at 60°C for 48 hours prior to weighing.

Fig. 4.9 shows the cumulative dry weight of fecal pellets produced in each sieved solution during the 11 hour feeding period. G. setosus is apparently capable of ingesting and forming fecal pellets from particles down to <62μ in diameter, but not those particles <8μ or the <0.45μ fractions. After the experimental period, those amphipods used in the smallest two size fraction were offered unfiltered silty water to verify that they were capable of producing pellets. All of these animals produced numberous pellets except for one individual in the <8μ group. An analysis of variance was performed on the data from those treatments in which fecal pellets were produced. None of these sievings above the 8μ level resulted in a significant effect on cumulative fecal pellet weight.

During the above experiment it became obvious that the largest individuals were producing fewer fecal pellets than the small amphipods. The relationship between body size and fecal pellet production is presented in Fig. 4.10 for the unfiltered and 202μ filtered treatments. A log transformation of the data results in a better straight line fit than an arithmetic plot, indicating that fecal pellet production on this food source is exponentially related to body size. It is obvious that small individuals produce a greater quantity of feces than the large animals. This may indicate that large G. setosus are not predominantly sediment feeders, while small individual can rely on this resource. Another factor that may be partially responsible for this relationship is the well known effect of body size on metabolism in which the metabolic rate of small individuals is higher on a per gram basis than that of large individuals. However the slope of the metabolism--weight regression is usually close to -0.27 whereas that of the above fecal production--weight regression is much higher; -0.67 and -1.0 for the two data sets presented.

Peat Feeding Experiments

A series of experiments was set up to assess the role of terrestrial plant detritus (peat) in the trophic relationships of the shallow water marine ecosystem. Information relating to the following major questions was sought by these experiments:

1) Do animals that ingest terrestrial plant detritus derive any nutrition from this material?

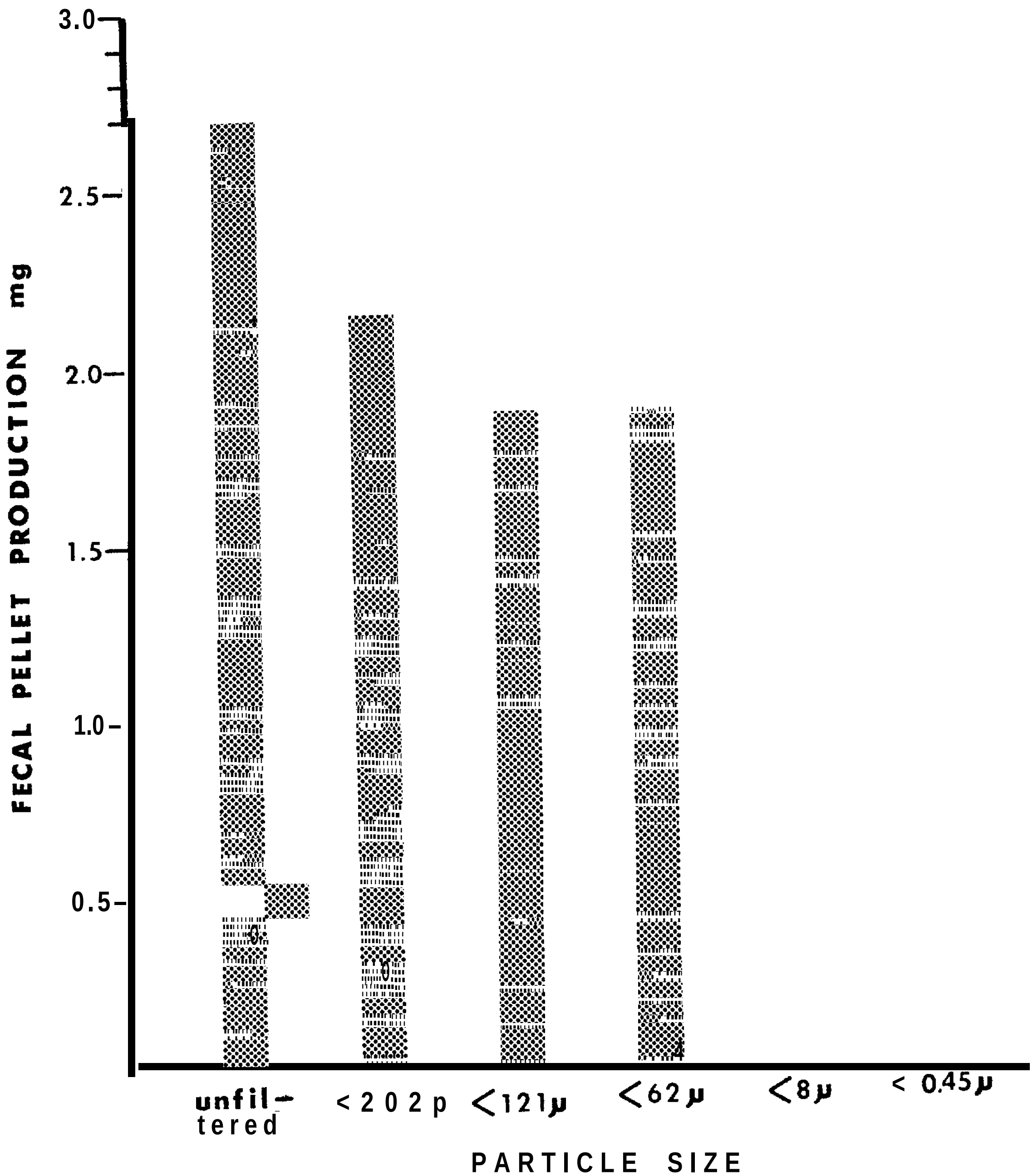


Fig. 4.9. Fecal pellet production by *Gammarus setosus* fed on different particle sizes derived from suspended sediments. The quantity shown is the cumulative dry weight of fecal pellets produced during an 11 hour feeding period.

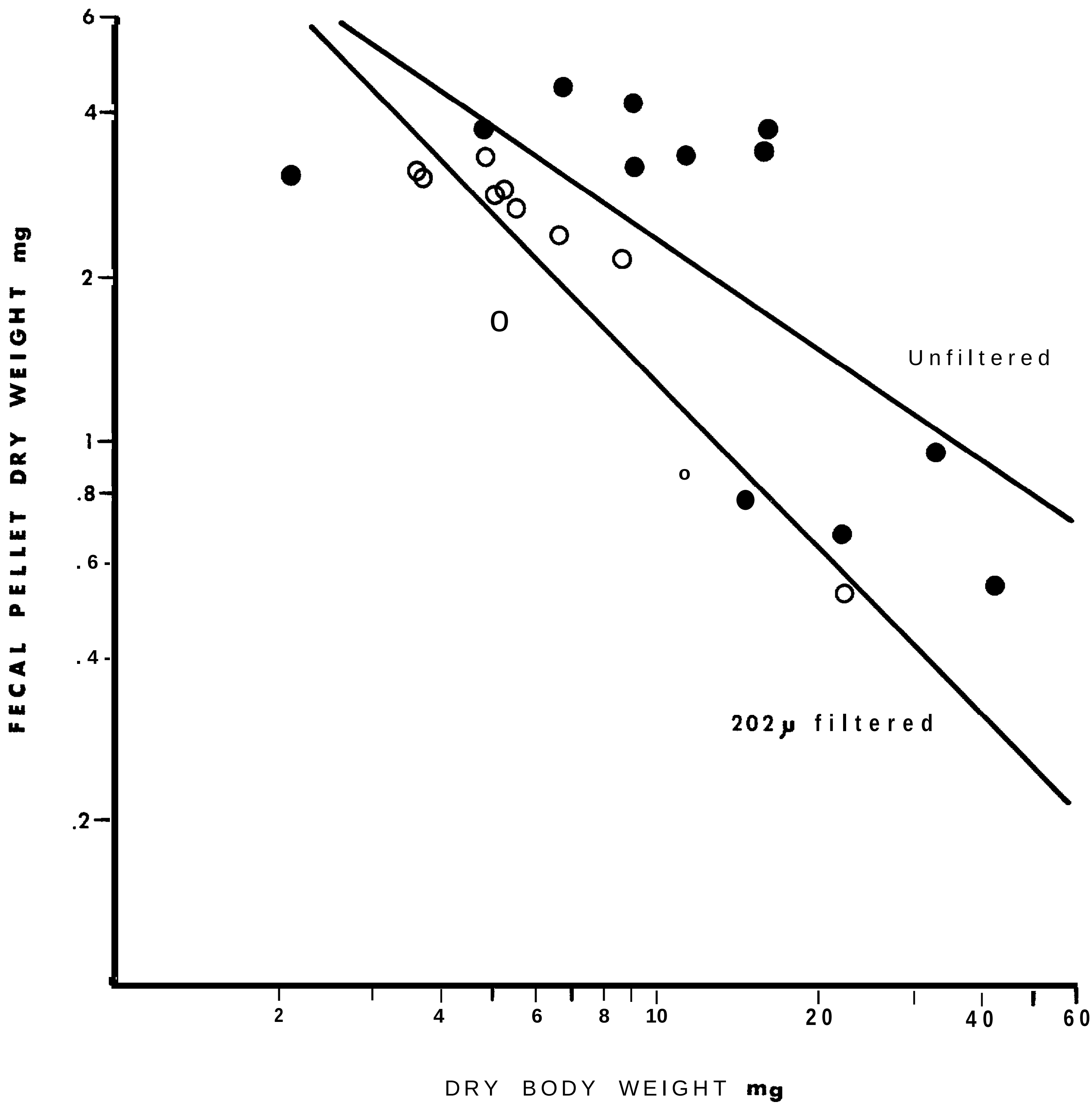


Fig. 4.10. The relationship between fecal pellet production and body size in Gammarus setosus fed on suspended sediment particles. The 202μ filtered fraction contained only particles smaller than this size.

2. If these species derive nutrition from this detritus, are they able to utilize the material directly or are they digesting the microorganisms that may be the primary agents of decomposition?
3. Do the species that utilize terrestrial plant detritus prefer a particular size fraction? In other words, is there a hierarchy of species required to utilize this material fully, some dealing with fairly large particles and reducing them to smaller sizes while other species only operate on small particle sizes?

Studies conducted during the summer of 1977 suggest that the abundant amphipod *Gammarus setosus* actively ingests large peat particles and in the process breaks them down into small size pieces. None of the other species investigated that summer even approached the ability of *G. setosus* to process peat particles. For this reason, the majority of the experiments were designed using this species as the test organism.

Organic content of peat size fractions. Peat enters the Arctic Marine ecosystem primarily as a result of erosion of receding coastlines. During this process, several stages can be recognized. First, undercutting of an eroding bluff by wave action causes a slumping of surface layers of sod and peat towards the active beach region. Further erosion causes pieces of this surface layer to fall onto the wave swept position of the beach. Breakup of these consolidated pieces is not immediate though and recognizable clumps can be observed in the shallow water for some time. Finally the wave action and currents completely disperse the clumps and distribute the peat particles throughout the marine system. The changes in organic content of peat as it progresses through this erosional process are of some interest since the peat may serve as a potential nutritional source.

Peat samples from three different stages in the above erosional process were obtained near Brant Point in Elson Lagoon. A portion of each sample was wet sieve through a graded series of nitex screens to yield six different partic e size classes. Samples of each size class were then analyzed for organic content using the weight loss upon ignition in a muffle furnace.

The results of hese analyses are shown in Table 4.2. Shallow water peat that has been in the marine system for some time has the lowest organic content. The peat from the clump on the beach and the eroding tundra that has not yet entered the marine system are quite similar in organic

Table 4.2. Organic Content of Peat Particle Size Fractions. Derived from several different sources.

Peat Size Fraction	Shallow Water Peat	Clump on Beach	Eroding Tundra
> 1050μ	76.1*	86.2*	84.1
425 < x < 1050μ	67.1*	81.1	85.2
202 < x < 425μ	55.0	81.0	81.1
102 < x < 20211	53.9	81.3	84.8
63 < x < 102μ	47.2*	74.5*	84.4
< 63μ	29.6*	36.4*	68.4*

*Significantly different from all other means of the same peat source at the 95% confidence level according to a Newman-Keuls multiple range test. Those means not asterisked are not significantly different from each other.

content except for the smallest size fraction. In most cases the smaller size fractions have a lower organic content than the larger particle sizes. Both of these trends may be the result of biological decomposition processes. Small sized particles in both terrestrial and the marine ecosystem may be formed as decompose organism utilize the detritus. Microscopic examination of the size fractions of the shallow water peat suggest that a high proportion of the material in the two smallest size classes may be derived from fecal pellets of amphipods and other shallow water marine animals. The material in the $63 < x < 102\mu$ size fraction was in clumps that teased apart in a similar manner as the amphipod fecal pellets. The $<63\mu$ fraction contained a high proportion of material that looked identical to a fecal pellet that had been already teased apart. If this suggestion is correct, the lower organic content of the small particle sizes may be the result of utilization of the less refractory organic material by shallow water organisms. Some of the decline in organic content after the peat enters the marine ecosystem may be the result of leaching of organic material from the particles.

Peat particle size fraction feeding experiment. An experiment was set up to determine the capabilities of *G. setosus* to feed upon and assimilate organic material from different particle sizes of peat. The peat used in the experiment was derived from the same sample that was used for organic content analysis of shallow water peat presented in Table 4.2. Size fractions were also the same as used in the organic content analysis. Eight replicate samples of each size fraction were introduced into compartmented polystyrene boxes by pipetting 2 ml aliquots of a constantly stirred heavy suspension into each compartment with a large bore automatic pipette. Each compartment contained about 50 ml of Millipore filtered sea water (31% salinity). The $>1050\mu$ fraction could not be pipetted and instead 5 mg damp weight was placed in each compartment. One *G. setosus*, previously starved for several days, was introduced into each compartment. Fecal pellet production was monitored over a 10.5 hour period and pellets were removed to another container at approximately 1 hour intervals. At the end of 10,5 hours amphipods were removed to clean boxes to allow gut clearance. All fecal pellets from each animal were pooled for dry weight and organic content determination.

Fecal pellet production was much higher when the amphipods were feeding on the smallest size fraction, <631.1, than when larger particles were offered (Fig. 4.11). A l-way analysis of variance followed by a Newman-Keuls multiple range test indicate that there is a significant effect of particle size on fecal pellet production ($p < .01$) but that only the <63μ size fraction treatment was significantly different from the others ($p < .05$). Assimilation efficiencies were calculated from the organic contents of peat and feces using Conover's (1966) equation and these values are presented in Table 4.3. Assimilation of organic matter is inversely related to peat particle size. Substantial assimilation only occurred when G. setosa was feeding on the largest size fraction. Assimilation was still positive but not high with the 425 < x < 1050μ fraction and became increasingly negative with smaller size fractions. Since the organic content of the peat is also inversely correlated with particle size (Table 4.3) it is possible that the high feeding rate with the smallest particle size is a response to the decreased organic content of this fraction. If so, the increased feeding rate is of no apparent benefit to the amphipod with this food source since the assimilation is so negative (-40.9%). On another food source with less refractory organic matter this behavior could have adaptive significance. Further experiments are necessary to determine whether feeding rates are actually related to organic content of food.

Peat assimilation experiments with Gammarus setosus. A more detailed series of experiments was designed to investigate the ability of G. setosus to assimilate organic material from peat and other terrestrial plant detritus. The general procedures followed in all of these experiments were those described earlier in the methods section. An estimate was made of the initial dry weight of food presented to each animal and the final amount of food following feeding was quantitatively collected for dry weight analysis. The difference between these two values provided an estimate of the dry weight of the food ingested. This value was used along with the dry weight of fecal pellets produced to calculate the gravimetric

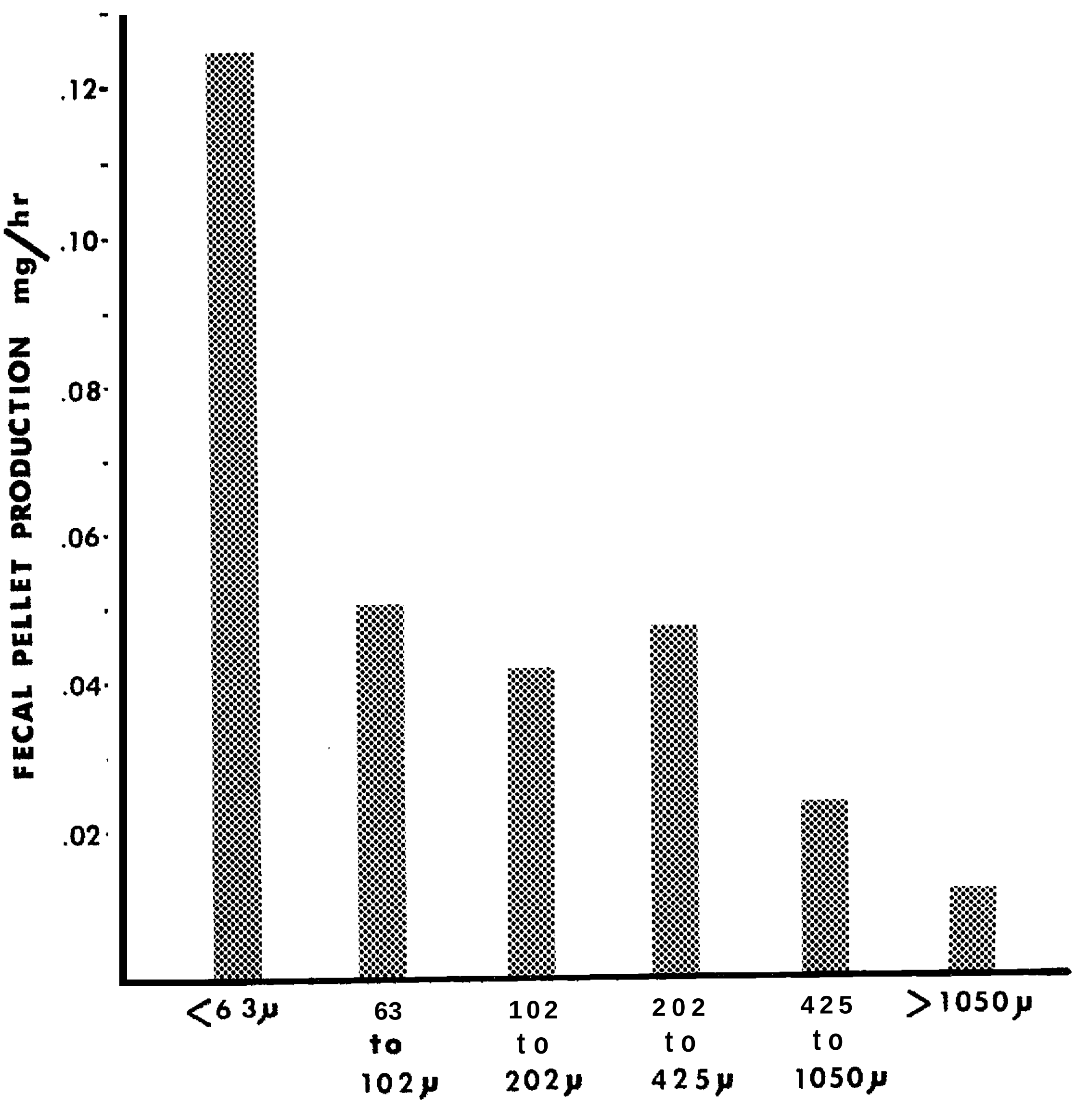


Fig. 4.11. Fecal pellet production rate by *Gammarus setosus* fed on different particle sizes of peat.

Table 4.3. Gammarus setosus Peat Size Fraction Feeding Experiment

Peat Size Fraction	Fecal Pellet Production mg/hr	Peat % Organic	Fecal Pellet % Organic	Conover's % Assimilation
> 1050μ	0.011	76.1	43.4	75.9
425 < x < 1050μ	0.023	67.1	62.1	19.7
202 < x < 425μ	0.047	55.0	58.2	-13.9
102 < x < 202U	0.042	53.9	59.2	-24.1
63 < x < 102μ	0.050	47.2	56.4	-44.7
< 63μ	0.124	29.6	37.2	-40.9

assimilation efficiency for the food used. In addition, the organic content of both food and feces was determined so that the percent assimilation based upon Conover's (1966) equation could be calculated.

In view of the large discrepancies between the gravimetric and Conover's assimilation efficiencies in the experiments about to be described, a discussion of the relative reliability of these measurements seems in order. Of the two efficiencies, the gravimetric assimilation is probably most prone to experimental error. To calculate this assimilation an accurate estimate of dry weights of food ingested and feces produced must be obtained. Unfortunately the peat could not be dried to provide an accurate measure of the amount of food offered to each animal without destroying the natural microflora associated with the peat. Instead an indirect measure of the initial amount of peat had to be used. In the case of small particle sizes, replicate aliquots were directly filtered on tared glass fiber filters for dry weight analysis. The pipetting of suspensions of particles cannot be absolutely precise and in some cases the total range of weights was as much as 6-7% of the total weight delivered to the experimental containers. Experiments with coarse fractions of peat necessitated the use of a standard blotting technique and the determination of a damp dry weight for the initial peat offered to each animal. Dry weight values were estimated by using a damp dry to dry weight conversion factor derived by directly determining the dry weight of damp-dried portions of the same peat. The errors associated with blotting to a consistent damp weight can be considerable even when care is taken to use a standardized procedure. Finally, the quantitative collection of fecal material can be a problem. Fecal pellets produced on small particle size fractions of peat tend to be well formed and are easily recognizable from the food particles. However, the pellets formed while feeding on coarse peat particles, although initially well formed, tend to fragment easily. Although an effort was made to preserve the integrity of these pellets by letting them fall through a screen to separate them from the food and animal, there still may have been some loss of fecal material. A low estimate of food production would bias the assimilation efficiency upwards.

The sources of experimental error associated with the Conover's assimilation efficiency are fewer. As long as an adequate sample of food and feces can be obtained, the primary source of error is associated with the actual dry weighings and ashing process. There are, however, two assumptions that are made when this equation is used. First, the food sample taken for organic analysis must be identical in composition to the material actually ingested. Second, it is assumed that there is no ash assimilation and that the dry weight of ash in the feces is the same as the ash dry weight ingested. The first assumption improbably correct for G. setosus as long term peat feeding experiments conducted during the summer of 1977 showed that this species would eventually ingest nearly all of the coarse peat offered. The second assumption may not be correct. Ash assimilation has been found to be substantial in other studies of aquatic animals (Lasenby and Langford, 1973; Pavlyutin, 1970) and in the present experiments the ash content of the feces was frequently lower than the estimate of ash ingested. It should be pointed out though that the estimate of ash ingestion by gravimetric methods is confounded by the same errors encountered in the estimation of total food ingestion. If there is significant ash assimilation, the estimate of organic assimilation by Conover's equation will be low. Conover's equation therefore provides a conservative estimate of organic assimilation. In the present study where we are interested in determining whether animals are capable of deriving nutrition from specific food items, use of the method of calculating assimilation efficiencies that is most conservative and least subject to experimental error seems preferable. For this reason, the majority of the conclusions will be based upon the Conover assimilation efficiencies.

Two experiments were run using small sized peat particles from shallow marine water as food. The <63µ fraction was used in the first experiment and the 63 < x < 102µ fraction in the second. The results of these experiments are shown in Table 4.4. When the <63µ was used as food the gravimetric assimilation was very low. A paired sample t-test comparing the dry weight ingested with the dry weight of the feces indicated no significant difference ($p > .05$) between the means. Therefore the gravimetric

Table 4.4. Terrestrial Plant Detritus Feeding Experiments with *Gammarus setosus*.

Food Type	Exp. duration	n	mg Ingested	mg Feces	Gravim. Assim. %	Food % Organic	Feces % Organic	Conover's Assim. %
Peat < 63µ	12 hr	6	3.08	2.96	3.9	32.6	34.9	-10.8
Peat 63 < x < 102µ	35 hr	12	1.28	0.88	31.2	35.7	41.1	-25.7
Peat >1.168mm	10 hr	19	0.9	0.79	12.2	70.4	45.1	65.4
Peat >1.168 mm	24 hr	10	1.08	0.79	26.9	75.4	43.3	75.1
Peat >1 mm	24 hr	12	5.11	1.44	71.8	79.0	56.7	65.2
Eroding Tundra Peat >1mm not presoaked	24 hr	12	3.5	1.16	66.9	84.0	82.2	12.0
Eroding Tundra Peat >1mm presoaked in raw seawater	23.5 hr	12	0.6	0.80	-33.3	83.5	84.3	-6.1
Dried Tundra Vegetation not presoaked	50 hr	12	3.0	0.91	69.7	93.1	82.1	66.0
Dried Tundra Vegetation presoaked in raw sea water	42 hr	12	5.34	1.34	74.9	88.5	81.9	41.2

assimilation of 3.9% should not be considered different from zero. The organic content of the fecal pellets was found to be significantly higher (t-test $p < .05$) than that of the food. This caused the assimilation efficiency based upon Conover's (1966) equation to be negative. Similar trends were found when the $63 < x < 102\mu$ fraction was used, except that the dry weight of the food ingested was significantly higher (t-test $p < .05$) than the dry weight of feces produced. This indicates that the gravimetric assimilation of 31.2% is greater than zero. However the Conover assimilation was negative as a result of a significantly greater percent organic (paired sample t-test $p < .05$) in the feces than in the food. It is concluded from these experiments that *G. setosus* does not derive any nutrition from peat particles smaller than 102μ.

Three experiments were set up using a coarse fraction of peat >1mm particle size. The peat was collected in the shallow water of Elson Lagoon and had been exposed to marine conditions for an undetermined amount of time. Table 4.4 shows the results of these experiments. The gravimetric assimilation values are widely divergent among the three experiments, although the mean dry weights ingested are in all cases significantly higher than the mean dry weights of all the feces (t=tests $p < .05$). Errors in estimating the initial food offered and the fecal material produced are suspected as a contributing factor to this variation. The Conover assimilation efficiencies are surprisingly high and reasonably consistent. Considering the refractory nature of the organic material left in the peat, assimilation efficiencies as high as 65-75% were not anticipated. Although peat that has been exposed to marine conditions develops a microflora of bacteria, diatoms, and filamentous algae, microscopic examination of this material suggests that these components comprise a very small fraction of the peat by weight. The only other reasonable conclusion is that *G. setosus* is somehow able to digest and assimilate the refractory organic materials that comprise the terrestrial plant detritus. Other animals that utilize cellulose and other plant structural organic compounds usually must do so with the help of symbiotic microorganisms. The enzymes necessary for the digestion of these materials are rare in animals. Whether this is true in *G. setosus* must await further experimentation.

Since _G. setosus_ can apparently utilize a coarse fraction of peat that has been soaking in seawater for some period, its ability to utilize plant detritus that has just entered the marine system became of interest. Two experiments were set up to examine the assimilation of peat from an eroding tundra bank. The peat was collected from a slumped surface slab of tundra near Brant Point in Elson Lagoon. The material had not yet entered the marine system but was in the process of eroding into the active beach. The peat was sieved to retain the >1mm fraction of particles. Two different procedures were employed in the experiments. The first experiment used peat that had been soaked in Millipore filtered sea water for 2 days. This procedure was employed to soften the peat and allow clumps to be broken up without exposing the material to marine microbes. The second experiment used peat that had been soaked in raw unfiltered sea water for one week at 5°C in a lighted incubator. Presumably this treatment allowed some marine microbes to develop on the peat.

The results of these experiments are presented in Table 4.4. Again the gravimetric assimilation efficiencies are widely divergent. In the first experiment where the peat was not presoaked in raw sea water there is a significant difference between the mean dry weight of food ingested and fecal pellets produced (paired sample t-test $p < .05$). However in the second experiment these values are not significantly different (paired sample t-test $p > .05$). This suggests that the assimilation efficiency of -33.3% is not really different from zero. Errors in estimating the initial dry weight of peat in this second experiment were apparent as several of the animals showed negative ingestion but produced at least 1 mg of fecal pellets. The true gravimetric assimilation has probably been underestimated in this case. The percent organics for food and feces are not significantly different for either experiment (t-test $p > .05$). Therefore the low values for the Conover organic assimilation efficiency are not significantly different from zero. This indicates that _G. setosus_ apparently cannot derive nutrition from peat that has recently entered the marine ecosystem. Even after the eroding tundra peat has soaked in raw sea water for a week there is no change in the ability of

G. setosus to assimilate the peat. Apparently a longer residence time in the marine system is necessary before the material can be used. Exactly what changes take place to make the peat more easily assimilated is not clear at this point.

As tundra surface material erodes into the marine system it is inevitable that freshly killed vegetation will also become available as a potential food item. It was of interest to contrast the assimilation of this fresh material with that of the older more completely decomposed terrestrial peat. Two experiments were set up using dried tundra vegetation as the food. Only the above ground leaves were used and these were dried in the laboratory at 20°C before use. Control and experimental portions of the dried material were weighed out and introduced into the chambers. The control portions were allowed to soak in Millipore filtered sea water for the same length of time as the experimental portions to allow a correction for loss due to leaching. Two different soaking procedures were employed in the experiments. In the first experiment the dried vegetation was placed directly into the experimental chamber without any presoaking. In the second experiment, the dried material was soaked in raw sea water for 10 days prior to being offered to the amphipods. The control portions for this second experiment also underwent a 10 day soaking in raw sea water to correct for leaching.

The results of these experiments appear in Table 4.4. Gravimetric assimilation efficiency is high in both experiments and the mean dry weights of ingested food and feces produced are significantly different (paired t-test $p < .05$). In these experiments the estimate of the initial amount of food offered is more reliable than in the previous experiments because the material was dried before the portions were weighed out. The Conover assimilation efficiencies are high for both experiments and the percent organics for food and feces are significantly different (t-test $p < .05$). There is a suggestion that the assimilation of the grass soaked in raw sea water is lower than that of freshly immersed grass. This trend could be the result of loss of easily assimilated organic material by leaching. During the soaking process there was an obvious loss of some material into the water and tiny oil droplets appeared in the chambers. Although the assimilation of dried tundra grass is similar to peat from shallow marine waters, the material being removed in each case may be quite different. The dried grass should still contain a high proportion of fairly easily digested organic compounds whereas these less refractory components should have disappeared from the peat that has soaked in the marine ecosystem for some time.

In summary, the results of the peat feeding experiments with G. setosus indicate that this amphipod can assimilate organic matter from a coarse particle size fraction of peat provided it has been in the marine ecosystem for a period of time. G. setosus does not assimilate organic matter from fine particulate fractions of marine peat nor from coarse fractions of peat freshly eroded into the marine ecosystem. This species can assimilate organic matter from dried fresh tundra vegetation that has freshly entered the marine ecosystem.

Laminaria assimilation by Gammarus setosus. Fragments of the kelp. Laminaria are frequently found in the shallow waters during the summer months. Apparently these plants are only found growing in those areas where boulders or cobbles provide the necessary attachment for their holdfasts. Although these areas are not abundant along the Beaufort Sea coast, there is enough release of material from these algal communities to provide a potential supplemental nutritional source for shallow water organisms. An experiment was set up to examine the ability of G. setosus to assimilate pieces of Laminaria detritus. The Laminaria pieces were cut into equal sized small squares, damp dried by pressing between sheets of Whatman No. 1 filter paper with a petri dish, and weighed before placing them in the experimental chambers. Control squares were damp dried using the same technique, weighed, fried at 60°C for at least 12 hours and reweighed to provide a dampdry to dry weight conversion for the experimental squares. The remaining procedures were the same as described in the Methods section for the coarse peat feeding experiments.

The results for this experiment are shown in Table 4.5. There was good agreement between the gravimetric and Conover assimilations for this experiment. Estimates of the initial amounts of food presented are fairly

Table 4.5. _Laminaria_ detritus feeding experiment with _G. setosus_.

Food Type	Exp. duration	n	mg ingested	mg feces	Gravim. Assim. %	Food % Organic	Feces % Organic	Conover's Assim. %
Laminaria pieces	10 hr	10	1.85	0.54	70.8	79.2	51.9	71.7

Table 4.6. _Mysis litoralis_ Peat Feeding Experiments.

Food Type	Date	Exp. duration	n	mg Ingested	mg Feces	Grav. Assim. %	Food % Organic	Feces % Organic	Conover's Assim. %
Peat < 63µ	8/78	24 hr	10				35.3	32.6	11.3
Peat < 63µ	8/78	24 hr	9	4.96	4.72	7.81	19.2	18.9	1.9
Peat 63 < x < 102µ	2/79	24 hr	11				35.4	36.0	-2.6

reliable due to the consistency with which this material could be blotted to a damp dry weight. The results indicate that G. setosus can successfully use drifting Laminaria pieces as food. Microscopic examination of fecal pellets produced on this food source indicated that the contents of most of the cells were digested.

Mysis littorals peat feeding experiments. Mysis littoralis is a common shallow water species that has been frequently observed in areas rich in peat. Experiments during the summer of 1977 with mysids feeding upon a coarse peat fraction were inconclusive. There was some indication of a low level of feeding on these large particles, but the results were not statistically significant. Preliminary observations with this species indicate that a wide range of particle sizes of peat can be ingested and fecal pellets are produced. The ability of Mysis littorals to assimilate fine particulate fractions of peat was investigated in three experiments. Two experiments were run during August 1978, the third was run in February 1979 under winter conditions of temperature, salinity and photoperiod. In the first and third experiment food ingestion and fecal pellet production were not quantitatively estimated. Samples of food and feces were processed for organic content analysis so that Conover's assimilation could be calculated. In the second experiment food ingestion and fecal pellet production was quantitatively measured to allow gravimetric assimilation to be calculated.

The results of the Mysis peat assimilation experiments appear in Table 4.6. The gravimetric assimilation for the second experiment is low but may be considered greater than zero because the dry weight ingested is significantly greater than the dry weight of feces produced (paired t-test $p < .05$). The percent organic for food is not significantly different from the percent organic for feces in any of the experiments (t-tests $p > .05$). This indicates that none of the Conover assimilation efficiencies are different from zero. Although Mysis littorals will ingest small peat particles, it appears that they do not derive any nutrition from them.

ATP analysis of food and feces. ATP content has been used as a measure of microbial biomass in ecological studies (Helm-Hansen and Booth, 1966; Lopez et. al., 1977). Studies have shown that ATP does not occur free from living cells and the ATP content of living cells is fairly constant. The determination of ATP content per unit of biomass for a number of diatoms and bacteria in pure culture has provided a basis for estimating microbial biomass. A C:ATP ratio of 285:1 has been suggested as an average value (Helm-Hansen, 1973) and that value is used in this study. Several experiments were set up to measure the ATP content of food and of fecal pellets egested after feeding on the food. The procedure used in these experiments was identical to that used in the assimilation experiments except that the food and fecal pellets were subjected to the ATP extraction procedure described in the methods. The eroding tundra peat had been soaked in a container of raw unfiltered sea water in a lighted incubator at 5°C prior to use in the experiment. Technical difficulties were encountered in these experiments and only those determinations in which 0.1 ml of extract was assayed provided reliable results. These results are shown in Table 4.7. The three size fractions of peat from marine waters show similar ATP levels (mean 0.00877 mg ATP/mg dry wt) suggesting that the microbial populations are similar. In contrast the ATP level of the eroding tundra peat was only 23% of the mean value for marine peats. This indicates a greatly reduced microbial population is present on peat that has not yet aged in the marine ecosystem. The ATP levels in fecal pellets from animals that have been ingesting peat in these experiments is higher than the levels in food. *Mysis littoralis* feeding on <63μ marine peat had about 5 times as high an ATP level as was found in the peat, the same comparison for *Gammarus setosus* feeding on >1mm eroding tundra peat indicates a 3 fold increase. In view of the fact that neither the gravimetric nor the organic assimilation efficiencies for the corresponding peat assimilation experiments were positive (Tables 4.4 and 4.6) the increase in ATP concentration suggests that the microbial populations on these types of peat are not being assimilated.

Table 4.7. ATP Content of Peat and Fecal Pellets. An estimate of microbial living carbon is obtained by multiplying the ATP values by 285 and converting from μg to mg.

	n	ATP μg/mg dry wt.	Living Microbial Carbon mg/mg dry wt."
Marine Peat < 1mm	10	0.00879	0.00251
Marine Peat 63 < x < 102μ	10	0.00825	0.00235
Marine Peat < 63μ	12	0.00926	0.00264
Mysis fecal pellets	12	0.0470	0.01339
Eroding Tundra Peat > 1mm	12	0.00202	0.00056
Gammarus fecal pellets	12	0.00599	0.00171

General Discussion

Primary production, particularly of benthic microalgae, appears to be one of the major sources of energy input to the shallow water Arctic marine ecosystem during the ice free period. Analysis of the composition of fecal pellets and gut contents indicates that the majority of epibenthic and benthic species studied feed at least in part on benthic microalgae. Matheke and Homer (1974) found that the benthic microalgae become the most important source of primary productivity after breakup of the shore-fast ice and that productivity of these organisms exceeds that of the phytoplankton by a factor of 2 and that of the ice algae by a factor of 8. The results of our fecal pellet analysis during the summer of 1977 indicate that planktonic diatoms can also be important when they are available. The view that is emerging from these studies is that many of the species are opportunistic feeders that make use of whatever resource is currently abundant.

Terrestrial plant detritus in the form of peat may be an important input of carbon for this ecosystem, especially during periods of low primary productivity. At present our information only indicates that a few species utilize significant quantities of peat. Gammarus setosus is able to ingest and assimilate large quantities of coarse peat particles, but does not derive nutrition from small sized particles. Analysis of fecal pellets and feeding experiments conducted during the summer of 1977 indicate that Saduria entomon and Mysis litoralis may also ingest peat. At present we only know that Mysis does not assimilate small particles of peat. Further experiments with coarse peat fractions are necessary to determine the importance of peat for these latter two species.

Our results suggest that Gammarus setosus can directly utilize the refractory organic matter found in peat. Most studies of benthic detritus feeding communities indicate that the animals that ingest detrital particles are actually deriving their nutrition from the microorganisms that grow upon these particles (Hargrave, 1970, 1976; Fenchel and Harrison, 1976; Mann, 1978). Thus the entry of detrital carbon into the detritivores is a 2-step process in these systems. Direct transfer of detrital carbon to the detritivore would provide a more efficient energy flow (Foulds and

Mann, 1978). If this capability is widespread in the Arctic shallow-water marine ecosystem, it could provide a significant increase in efficiency in this low energy input system. Several recent studies have indicated that direct transfer of detrital carbon to the detritivores is possible (Kofoed, 1975; Foulds and Mann, 1978). The presence of cellulase activity in marine invertebrates is widespread (Yokoe and Yasumasu, 1964; Elyakova, 1972) and has been reported for the genus *Gammarus* (Halcrow, 1971). We plan to conduct further experiments using radioactively labelled cellulose to more fully assess the possibility of direct transfer of detrital carbon in the Arctic marine ecosystem. Further experiments are also needed with meiofauna, particularly oligochaete and small polychaete worms to determine their importance in the decomposition of peat. It seems unlikely that these small organisms could directly utilize large peat particles and a 2-step transfer through microorganisms seems more likely.

LITERATURE CITED

Conover, R. J. 1966. Assimilation of organic matter by zooplankton. Limnol. Oceanog. 11:338-345.

Elyakova, L. A. 1972. Distribution of cellulases and chitinases in marine invertebrates. Comp. Biochem. Physiol. 43:67-70.

Fenchel, T. and Harrison, P. 1976. The significance of bacterial grazing and mineral cycling for the decomposition of particulate detritus, p. 285-299. In Anderson, J. M. and Macfadyen, A., eds. The role of terrestrial and aquatic organisms in decomposition processes. Blackwell Sci. Publ., London.

Foulds, J. B. and K. H. Mann 1978. Cellulose digestion in Mysis stenolepis and its ecological implications" Limnol. Oceanog. 23:760-766.

Halcrow, K. 1971. Celluslase activity in Fammarus oceanicus Segerstrale (Amphipoda). Crustacean 20:121-124.

Hargrave, B. T. 1971. Cellulase activity in Gammarus oceanicus Segerstrale (Amphipods). Crustacean 20:121-124.

Hargrave, B. T. 1970. The utilization of benthic microflora by Hyalella azteca (Amphipoda). J. Anim. Ecol. 39:427-437.

Hargrave, B. T. 1976. The central role of invertebrate faeces in sediment decomposition, p. 301-321. In Anderson, J. M. and Macfayden, A., eds. The role of terrestrial and aquatic organisms in decomposition processes. Blackwell Sci. PubI., London.

Helm-Hansen, O. 1973. Determination of total microbial biomass by measurement of adenosine triphosphate. In: Estuarine Microbial Ecology (L. H. Stevenson and R. R. Coldwell, eds.), pp. 73-89. Columbia: University of South Carolina Press.

Helm-Hansen, O. and R. C. Booth. 1966. The measurement of adenosine triphosphate in the ocean and its ecological significance. Limnol. Oceanog. 11:510-519.

Kofoed, L. H. 1975. The feeding biology of Hydrobia ventrosa. 2. Allocation of the components of the carbon-dudget and the significance of the secretion of dissolved organic material. J. Exp. Mar. Biol. Ecol. 19:243-256.

Lasenby, D. M., and R. R. Langford. 1973. Feeding and assimilation of Mysis relicta. Limnol. Oceanogr. 18:280-285.

Lopez, G. R., J. S. Levinton and L. B. Slobodkin. 1977. The effect of grazing by the detritivore Orchestia grillus on Spartina litter and its associated microbial community. Oecologia 30:11-127.

Mann, K. H. 1976. Decomposition of marine macrophytes, p. 247-267. In: J. M. Anderson and A. Macfadyen (eds.), The role of terrestrial and aquatic organisms in decomposition processes. Blackwell.

Matheke, G. E. M. and R. Homer. 1974. Primary productivity of the benthic microalgae in the Chukchi Sea near Barrow, Alaska. J. Fish. Res. Board Can. 31:1779-1786.

Pavlyutin, A. P. 1970. A contribution to the method of determination of food assimilation in aquatic animals. Zool. Zh. 49:288-293.

Stanley, P. E. and S. G. Williams. 1969. Use of the liquid scintillation spectrometer for determining adenosine triphosphate by the luciferase enzyme. Analyt. Biochem. 29:381-392.

Yokoe, Y., and 1. Yasumasu. 1964. The distribution of cellulase in invertebrates. Comp. Biochem. Physiol. 13:323-338.